PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

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Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
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X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the left. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C. number in the text. The main headings are listed above.

An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, " : " e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

[*Continued on page* 3 *of cover*

MATHEMATICS 51

512.25 180

An escalator process for the solution of linear simultaneous equations. MORRIS, J. *Phil. Mag.*, **37**, 106–20 (*Feb.*, 1946).—The process, which was originally devised for the solution of a set of Lagrangian frequency equations [Abstr. 1182 (1945)], is now extended to apply to a more general set. A numerical example relating to a set of 6 symmetrical equations is solved in detail. L. S. G.

512.52 181

Interpolation with the aid of a plot of first differences. FULCHER, G. S. *J. Appl. Phys.*, **17**, 617–28 (*July*, 1946).

517.512.2 182

An expression for the sine of a Fourier series. STRACHEY, C., AND WALLIS, P. J. *Phil. Mag.*, **37**, 84–6 (*Feb.*, 1946).—The expression is obtained by generalizing a well-known formula in the theory of Bessel functions. It is exact, and useful for numerical purposes when only the first few terms are sufficient. An example is discussed and a table is given for facilitating application. L. S. G.

517.512.2 : 621.3.011 = 5 183

The Fourier integral. SARTORI, R. *Alta Frequenza*, **9**, 531–52 (*Aug.-Sept.*, 1940) *In Italian.*—[Abstr. 283 B (1947)].

517.516 184

Hahn's functions $S_m(\alpha)$ and $U_m(\alpha)$. STRACHEY, C., AND WALLIS, P. J. *Phil. Mag.*, **37**, 87–94 (*Feb.*, 1946).—Formulae for computing the functions are derived and tables of values are given. The results have been published earlier [Abstr. 630 (1941)]. L. S. G.

517.562 : 621.317.39 : 518.5 *see Abstr.* 187

517.65 : 534.26 185

The diffraction of sound pulses. III. Note on an integral occurring in the theory of diffraction by a semi-infinite screen. FRIEDLANDER, F. G. *Proc. Roy. Soc. A*, **186** (*No.* 1006) 352–5 (*Sept.* 24, 1946).—The integral is

$$P(X, T) = \pi^{-1}X^{\frac{1}{2}}\int_0^T p_0(u)(T + X - u)^{-\frac{1}{2}}(T - u)^{-\frac{1}{2}}\,du$$

and complete expansions, for large and small X, are given. The magnitudes of the remainders are estimated. An expansion is also given which is valid when T and X are both small. For applications see Abstr. 257–9 (1947). L. S. G.

518.5 186

On a principle of connexion for Bush integrators. AMBLE, O. *J. Sci. Instrum.*, **23**, 284–7 (*Dec.*, 1946).—A Bush integrator is a precision means of interconnecting three shafts so that their rotations u, v, w have the relation $w = \int v\,du$, with an associated torque amplifier. A regenerative connection is one for which the output rotation w contributes to the input rotation u. A survey is made of regenerative connections involving one and two integrators. By use of such connections, it is possible to generate a logarithm or square root by use of one integrator, and any rational power by the use of two integrators. It is also possible to obtain a step-up gear ratio without loss of torque, and this can be applied to mechanical differentiation. A.

518.5 : 517.562 : 621.317.39 187

A simple potentiometer circuit for production of the tangent function. HOFSTADTER, R. *Rev. Sci. Instrum.*, **17**, 298–300 (*Aug.*, 1946).—[Abstr. 376 B (1947)].

519.2 188

An invariant form for the prior probability in estimation problems. JEFFREYS, H. *Proc. Roy. Soc. A*, **186** (*No.* 1007) 453–61 (*Sept.* 24, 1946).—The problem solved is that of giving a general rule for assessing prior probability. A certain differential form in $\alpha_1, \ldots, \alpha_m$, the parameters in a law of chance, is set up and this form is invariant for all transformations of $\alpha_1, \ldots, \alpha_m$ when the law is differentiable with regard to (α). When the law is not everywhere differentiable a form with a restricted invariance is found and this is applicable also in the case of laws containing a location and a scale parameter. The form yields a general rule for prior probability. A modified form is obtainable in cases where the chances are not differentiable, e.g. the rectangular distribution, or the sampling of a finite population. The relationship with χ^2 and maximum likelihood is discussed briefly. L. S. G.

519.21 : 537.542 : 539.16.08 = 82 *see Abstr.* 415

519.21 : 621.318.572 : 539.16.08 = 82 *see Abstr.* 416

519.213 : 533.72 *see Abstr.* 238

519.241.6 189

The logarithmic transformation. STEVENS, W. L. *Nature, Lond.*, **158**, 622 (*Nov.* 2, 1946).—[See Abstr. 3043 (1946)].

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.112 190

On the gravitational stability of the expanding universe. LIFSHITZ, E. *J. Phys., USSR*, **10** (*No.* 2) 116–29 (1946).—The gravitational stability of non-stationary isotropic models of the universe is investigated. It is shown that arbitrary small perturbations of the gravitational field and of the distribution of matter in the expanding universe either

decrease with time or increase so slowly that they cannot serve as centres of formation of separate nebulae or stars. A.

523.165 : 621.396.821 191

Variation of cosmic radiation with frequency. MOXON, L. A. *Nature, Lond.*, **158**, 758–9 (*Nov.* 23, 1946).—Extended measurements of galactic radiation of frequencies 40, 90 and 200 Mc/s are reported, using directional aerials [see Abstr. 1205 (1946)]. The results, plotted in terms of an "equivalent noise temperature" T, show the relation $T \propto (\text{frequency})^{-2 \cdot 7}$. No significant variation of index with galactic latitude was found. The departure from an inverse cube law is just small enough to be attributable to experimental errors. The variation of the minimum equivalent noise temperature T_m is given by $T_m \propto (\text{frequency})^{-2 \cdot 1}$, and the difference of index appears to be real.

523.2 : 621.317.39 : 621.396.96 192

Astronomical radar. Some future possibilities. CLARKE, A. C. *Wireless World*, **52**, 321–3 (*Oct.*, 1946).—[Abstr. 564 B (1947)].

523.31 : 621.317.39 : 621.396.96 = 82 193

Measurement of earth-moon distance by means of electromagnetic waves. PAPALEKSI, N. D. *Elektrichestvo* (*No.* 5) 9–15 (1946) *In Russian.*—The problem of pulse-echo method of time measurement as applied in radar is analysed thoroughly. The surface of the moon is assumed to be of semi-reflecting nature, Lambert's law is applied, and pulse forms after reflection from the moon are calculated, based on three phases, the 1st phase being contact of the leading edge of the pulse with the moon, the 2nd phase contact of the trailing edge with the moon, the 3rd phase penetration of the centre of the moon. The importance of beam angle, and the "illuminated" area is discussed. Minimum power for reliable reception is calculated for different frequencies, including light and zenith angle, and shown to be practicable with power gains attained by modern aerial arrays and pulse transmitters. The possibility of the use of light waves (spark discharge) and the reception of the reflected light signal by means of photocells is quantitatively discussed, and a refinement proposed; the sending of pulses with distinct spectral lines which should improve the signal/noise ratio of reception. The feasibility of the experiment during a moon eclipse (to exclude reflected sunlight) is stressed. A. L.

523.72 : 535.33 : 539.156 194

Origin of radio-waves from the sun and the stars. SAHA, M. N. *Nature, Lond.*, **158**, 717–18 (*Nov.* 16, 1946).—[See Abstr. 17 (1947)]. The strong magnetic fields associated with the active sun can give rise to waves of metre wavelength by transitions between the nuclear spin levels of atoms and molecules. Such transitions have been observed in absorption, for alkali atoms, but solar phenomena will probably depend on hydrogen and hydrides, for which approximate calculations are here given.

523.72 : 621.396.821 195

Temperature radiation from the quiet sun in the radio spectrum. MARTYN, D. F. *Nature, Lond.*, **158**, 632–3 (*Nov.* 2, 1946).—It can be shown that radiations of wavelength $>$ about 1 m must emanate from the corona, whose temperature is of the order of 10^6 degrees [Abstr. 344 (1943)]. Shorter wavelengths originate lower down in the chromosphere, where the temperature is much lower. Though negligible 10 cm black-body radiation is, therefore, to be expected, there should be a measurable radiation in the band from 1 to 10 m. 10^6 degree decimetre radiation is, however, to be expected from the limb of the sun, where the corona, as seen from the earth, is "thick"; this phenomenon should be particularly noticeable in the region 20–60 cm and should be capable of experimental test with directive aerials or during eclipses.

523.72 : 621.396.821 196

Observation of million degree thermal radiation from the sun at a wavelength of 1·5 metres. PAWSEY, J. L. *Nature, Lond.*, **158**, 633–4 (*Nov.* 2, 1946).—Daily measurements were made over a period of 6 months of the received noise intensity, being the sum of the thermal radiation and the much higher, but variable, radiation associated with sunspots. The distribution of intensity values showed a high peak at a value corresponding to a radiator of temperature 10^6 degrees, with a sharp cut-off on the low-intensity side [see Abstr. 195 (1947)].

525.235 : 537.591.5 *see Abstr.* 378

PHYSICS 53

53.081 : 548.73 197

Frequency and repetency. FOKKER, A. D. *Physica, 's Grav.*, **12**, 351–2 (*Sept.*, 1946).—The use of the term "repetency" is suggested to denote the spatial analogue p of the frequency f in a periodic phenomenon in space and time

$$\phi = A \cos 2\pi(ft - p_x x - p_y y - p_z z)$$

Thus f represents the number of recurrences "per sec" and px represents the number "per cm." For a crystal lattice, px, py and pz taken together form a reciprocal vector, and the collection of these vectors is the reciprocal lattice, which is thus seen to be the spectrum of repetencies of the structure. The interaction of two periodic phenomena gives rise to addition and subtraction repetencies as well as frequencies.

FUNDAMENTALS 530.1

530.12 198

Unitary representations of the Lorentz group. GELF, I., AND NEUMARK, M. *J. Phys., USSR*, **10** (*No.* 2) 93–4 (1946).—The usual (finite-dimensional) representations of the Lorentz group do not leave invariant any positive definite form, i.e. are not unitary. All unitary (hence infinite-dimensional) irreducible representations of the Lorentz group are indicated. A.

530.12 199

Note on the possible relativistic-invariant generalization of the concept of field. BLOKHINZEV, D. *J. Phys., USSR*, **10** (*No.* 2) 167–9 (1946).—The possibility of interactions with a propagation velocity exceeding that of light, and compatible with the requirement of the Lorentz invariance, is discussed. A.

530.12 200

A five-dimensional field theory. WANG, K. C., AND CHENG, K. C. *Phys. Rev.*, **70**, 516–18 (*Oct.* 1 *and* 15, 1946).—The field equations and the interactions of the field and particles are obtained on the assumption of a five-dimensional space-time. In this theory, the electrodynamics is in agreement with the classical theory. In the case of the meson theory, the vector, pseudoscalar and pseudovector theories are obtained. A.

530.12 : 531.612 201

On the conservation of momentum. MILNE, E. A. *Proc. Roy. Soc. A*, **186** (*No.* 1007) 432–42 (*Sept.* 24, 1946).—A continuation of previous work [Abstr. 2384 (1937)]. Relations corresponding to the integrals of linear and angular momentum in the many-body problem of classical gravitational theory are obtained. It is concluded that Einstein's form of the conservation of linear momentum in special relativity, namely, that $\sum_i m_i v_i (1-v_i^2/c^2)^{-\frac{1}{2}}$ is conserved, is true in the universe at large only in the case of a collinear set of particles moving along their line of collinearity. When the accelerations are not parallel to the velocities the expression is not conserved and its rate of change is calculated. The modification of the law of conservation which should hold good in other cases is given. L. S. G.

530.145 202

On the principles of elementary quantum mechanics. GROENEWOLD, H. J. *Physica, 's Grav.*, **12**, 405–60 (*Oct.*, 1946).—The problems discussed are closely connected. (1) The correspondence $a \longleftrightarrow \mathbf{a}$ between physical quantities a and quantum operators $\mathbf{a}$ (quantization); (2) the possibility of understanding the statistical character of quantum mechanics by averaging over uniquely determined processes as in classical statistical mechanics (interpretation). The discussion is confined to elementary non-relativistic quantum mechanics of scalar (spinless) systems with one linear degree of freedom without exchange. Special attention is paid to the measuring process. A.

530.145 : 536.63 : 537.312.62 *see Abstr.* 345

530.145 : 537.533.74 *see Abstr.* 358

530.145 : 538.3 : 537.122 203

On Dirac's theory of quantum electrodynamics: the interaction of an electron and a radiation field. ELIEZER, C. J. *Proc. Roy. Soc. A*, **187**, 197–210 (*Oct.* 22, 1946).—The wave equation

$$[p_0 - \boldsymbol{\alpha} \cdot (\boldsymbol{p} - e\mathbf{A}) - m\beta]\psi = 0$$

is solved in the form

$$\psi = \psi_0 + e\psi_1 + e^2\psi_2 + \ldots$$

and it is shown that ψ_0, ψ_1, ψ_2 and ψ_3 are all finite. Let ψ_{nm} be that part of ψ_n which refers to m photons. It is found that ψ_4 has finite parts ψ_{44} and ψ_{42} but divergent ψ_{40}. All divergent integrals disappear for the particular solution, which corresponds to outgoing waves of the electron. ψ_{nm} is zero for all m different from n, and ψ_{nn} can be given explicitly. Processes involving any number of photons can now be considered exactly. L. S. G.

530.145 : 538.3 : 537.533.74 204

The application of quantum electrodynamics to multiple processes. ELIEZER, C. J. *Proc. Roy. Soc. A*, **187**, 210–19 (*Oct.* 22, 1946).—The results of the previous paper [Abstr. 203 (1947)] are used to calculate the order of magnitude of the transition probability for a scattering process in which an electron and 3 photons are involved. It is shown that this probability is large if one of the emitted photons is of low frequency. Thus quantum electrodynamics allows the possibility of photon showers in which the quanta are emitted simultaneously in a single process; this is contrary to Heitler's conclusions, perhaps because Heitler considers the frequencies of all the emitted photons to be of the same order of magnitude. L. S. G.

530.145 : 538.639 : 537.312.62 *see Abstr.* 344

530.145.6 205

On the theory of the motion of a particle in the Coulomb field. BLOKHINZEV, D. *J. Phys., USSR*, **10** (*No.* 2) 196 (1946).

530.145.65 = 4 206

The wave mechanics of elementary particles. I. KWAL, B. *Arch. Sci. Phys. Nat.*, **26**, 132–52 (*Sept.–Oct.*, 1944) *In French.*—Wave equations are set up for particles of any spin having a single associated wave. The equations involve the matrices, including the spin matrices, in the form of direct products; and they are divided into two groups, the primary and the secondary equations. The former are the simplest and are formed from spin matrices of the lowest possible rank. For a particle of spin j and zero rest mass there are 2^{2j-1} systems of primary equations. Secondary equations are either mixed or composite. A composite equation of degree k for a particle of spin j is obtained by considering a system of $k+1$ simultaneous primary equations; its form is such that the same function ψ appears in the mass term as in the rest of the equation. Finally, mixed composite equations are constructed. Dirac's equations appear as the composite equations of the first degree for $j = \frac{1}{2}$. The two systems of mixed equations for $j = 1$ give composed equations of the first degree which are equivalent. These are the de Broglie photon equations. L. S. G.

530.145.65 = 4 207

The wave mechanics of elementary particles. II. KWAL, B. *Arch. Sci. Phys. Nat.*, **27**, 5–25 (*Jan.–Feb.*, 1945) *In French.*—The particles studied have several associated wave-functions. When the number of wave-functions is g we speak of a g-wave particle. The primary equations are studied for 2-wave particles of spin 1, $\frac{3}{2}$ and j, for 3-wave particles of spin $\frac{3}{2}$ and j, and for g-wave particles of spin $\frac{1}{2}g$ and j. The secondary equations studied include: (1) The composite equations of the first degree for the 2-wave particle of spin 1 and the g-wave particle of spin j; (2) the mixed equations for the 2-wave particle of spin 1, the 3-wave particle of spin $\frac{3}{2}$ and the g-wave particle of spin j. Two outstanding properties of

multi-wave particles are: (1) The particle with an odd number of wave functions can possess a lowest half-integral spin, while that with an even number can possess a lowest integral spin; (2) the equations with an even number of wave functions are not affected by an electromagnetic field and are appropriate in a theory of neutral particles. L. S. G.

530.145.65 = 4 208

The wave mechanics of elementary particles. III. KWAL, B. *Arch. Sci. Phys. Nat.*, **27**, 95–121 (*May–June*, 1945) *In French.*—The relativistic variation of the wave equations is discussed. The secondary composite equations are written in spinor form, and the composite equations of the 7th degree for the particle of spin $\frac{1}{2}$ may be written down in terms of 8 spinors of rank 1, 4 spinors of rank 2 or 2 spinors of rank 4. The equations of multi-wave mechanics are next studied, and as an example the mixed and mixed composite equations are written in spinor form for the 2-wave particle of spin 1 and $\frac{3}{2}$, and for the 3-wave particle of spin $\frac{3}{2}$. The theory of plane waves is developed, and it is shown how the solution of the composite equations of the first degree ($j=\frac{1}{2}$) or the mixed composite equations of the first degree ($j\geqslant 1$) may be obtained by adjoining to a complete plane wave solution of the primary equations ($j=\frac{1}{2}$) or the secondary mixed equations ($j\geqslant 1$) a solution of a second system of equations. L. S. G.

530.145.65 = 4 209

The wave mechanics of elementary particles. IV–V. KWAL, B. *Arch. Sci. Phys. Nat.*, **27**, 167–90 (*Sept.–Oct.*, 1945) *In French.*—In IV, a study is made of equations which apply to particles moving with the velocity of light. These include the primary and secondary equations for particles of spin $\frac{1}{2}$, 1, $\frac{3}{2}$ and j. The composite equations of the first rank for the particle of spin $\frac{1}{2}$ are examined in detail, and an explicit matrix representation of the operators is given in this case. In V, the wave equations associated with the angular momentum are discussed. The primary equations for the particles of spin $\frac{1}{2}$, 1 or $\frac{3}{2}$ are given as examples, and the work finishes with a statement of the composite equations for the particle of spin 1. L. S. G.

530.145.65 : 535.14 210

The correspondence between the particle and the wave aspects of the meson and the photon. HARISH-CHANDRA. *Proc. Roy. Soc. A*, **186** (*No.* 1007) 502–25 (*Sept.* 24, 1946).—Certain matrices, Γ_k^*, are introduced into the Kemmer formulation of the meson equation [Abstr. 4466 (1939)]. These are determined by the condition that $\Gamma_k^*\psi$ behaves like a vector under a Lorentz transformation. These, and another matrix β, defined in terms of them, are convenient for discussing the properties of the meson matrices β_k. A formula for the spur of a product of any number of β_k's is derived for the 10- and 5-row representations. The Kemmer formulation is shown to be completely equivalent to the vector and scalar meson equations in tensor form. Nuclear interaction may be introduced into the Kemmer formulation and the extension of the "particle" formulation to a particle of zero rest-mass is discussed. A convenient representation of the β_k's is given both for spin 1 and 0. In this case the Γ_k^* and β are given explicitly. L. S. G.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.19 211

Expansions into a series of powers of a small parameter in the theory of statistical equilibrium. BOGOLUBOV, N. *J. Phys., USSR*, **10** (*No.* 3) 257–64 (1946).—Equations are derived connecting the distribution functions of different orders in the case of statistical equilibrium. These equations are solved using series expansions of powers of the density, and the formal expressions of the Ursell–Mayer theory are obtained. The case of Coulomb's interaction is also studied for which a special expansion method is developed. An approximate integral equation for the binary distribution function is derived. A.

531.19 212

Kinetic equations. BOGOLUBOV, N. *J. Phys., USSR*, **10** (*No.* 3) 265–74 (1946).—Equations are derived, based on those of classical mechanics, connecting the distribution functions of the various orders in the dynamical case. The usual expansions into a series of powers of the density are studied, the presence of two processes, a "slow" and a "fast," in the evolution of correlation distributions being established. A special method of expanding into a series of density powers is developed, enabling kinetic equations to be obtained, generalizing the Boltzmann kinetic equation. A.

531.258 213

Two-dimensional boundary-value problems of elasticity. SEN, B. *Proc. Roy. Soc. A*, **187**, 87–101 (*Oct.* 8, 1946).—The complex variable method is used to determine stress distributions in these cases: (1) a single force acting in the interior of an isotropic plate with a straight edge; (2) a single couple acting at a point inside an isotropic semi-infinite plate; (3) a point of pressure situated inside a plate; (4) cases (2) and (3) with a non-isotropic material; (5) couples or forces operating in the interior of an isotropic circular plate. L. S. G.

531.258 214

Boundary value problems of a heavy circular disk held in a vertical plane. SEN, B. *Phil. Mag.*, **37**, 66–72 (*Jan.*, 1946).—The stresses in the disc are calculated by the complex variable method [see Abstr. 213 (1947)]. L. S. G.

531.259 215

The distribution of stress in the neighbourhood of a crack in an elastic solid. SNEDDON, I. N. *Proc. Roy. Soc. A*, **187**, 229–60 (*Oct.* 22, 1946).—A crack in an infinite 2-dimensional elastic body is considered, and the body is deformed by the opening of the crack under the action of a uniform hydrostatic pressure acting over its surface. Expressions for the stress components and for the principal shearing stress are derived from Westergaard's solution of the elastic equations [*J. Appl. Mech.*, **6**, 49 (1939)]. Some numerical results are given. The case of a circular crack, in 3 dimensions, is analysed, in a cylindrical polar co-ordinate system, by the method of Hankel transforms [Abstr. 1621 (1945)]. The stress distribution in the case where the applied internal pressure

remains constant over the entire surface of the crack is considered in detail. The stress components are calculated at various points of the elastic body, and sets of tables allow the values at intermediate points to be obtained by interpolation. The principal shearing stress is also tabulated and the contours of equal principal shearing stress are plotted to show the distribution of stress near the crack. L. S. G.

531.612 : 530.12 *see Abstr.* 201

MECHANICAL MEASUREMENTS 531.7

531.7 : 621.317.39 216

The recording of strain by the "parallel resonance" method. BEACH, H. J. *Electronic Engng*, **17**, 737 (*Oct.*, 1945).—Describes a simple method of measuring and recording photographically small changes in physical dimensions by causing these changes to alter the spacing of the plates of a capacitor forming part of a parallel resonant circuit. The capacitor consists of 4 in square brass plates separated 0·1 in by a rubber gasket, and has a capacitance of 120 $\mu\mu$F, while the inductance is 933 μH. The LC combination is connected in series with the output from a beat-frequency oscillator operating at 15 kc/s and the grid circuit of a tetrode. The a.c. voltage on the grid, which varies with changes of capacitance, is rectified and amplified in the valve, the output being applied to a 402 c.r.t. D.c. connections are used so that a deflection results from a change of capacitance. Using an oscillator output of 20 V r.m.s., a depression of the capacitor gauge of 0·002 in corresponded to a 2·5 cm deflection on the c.r.o. H. G. M. S.

531.719.35 : 534.241 = 82 *see Abstr.* 256

531.787 : 534.222.2 217

A simple instrument for measuring blast. REINER, M. *J. Sci. Instrum.*, **23**, 288–9 (*Dec.*, 1946).—A simple instrument is described for measuring the intensity of blast from small charges. It consists of a plate, screening an opening in a wall, which is suspended on two strings from hooks above, and has in its centre a small fixed bracket supporting a steel ball. At the end of the pressure phase the ball separates from the plate and flies off in a trajectory reaching the floor at a distance w from the wall. The total impulse is $I = 22\,mw/\sqrt{h}$, where m is the mass of plate-*cum*-ball and h the height of the ball, at rest, above the floor level, all measures being in the c.g.s. system. A.

531.787.9 : 621.317.39 218

The electrical measurement of pressures and indicator diagrams. WILLEY, E. J. B. *J. Sci. Instrum.*, **23**, 264–9 (*Nov.*, 1946).—A brief discussion is given of the various methods. Apparatus of a simple kind is described, with working details, (*a*) for two pressure capacitors, (*b*) for a capacitance-coupled amplifier usable down to 5 c/s, (*c*) for a direct-coupled cathode-follower circuit and (*d*) for special non-linear time bases to convert pressure time curves into indicator diagrams. A.

MECHANICS OF LIQUIDS 532

532.13 : 532.5.032 *see Abstr.* 220

532.13 : 541.68 219

Viscosities of the di-hydroxybenzenes and some of their derivatives. FRIEND, J. N., AND HARGREAVES, W. D. *Phil. Mag.*, **37**, 120–6 (*Feb.*, 1946).—Viscometers of the Ostwald type were used to determine the viscosities, at various temperatures, of the following substances: *o*-, *m*- and *p*-dimethoxybenzene, *o*-, *m*- and *p*-methoxyphenol, *o*- and *m*-dihydroxybenzene and 2-nitroresorcinol. Viscosity-temperature curves are drawn. The results are used to discuss some features of molecular structure and equilibrium, especially hydrogen bonding. L. S. G.

532.5.032 : 532.13 220

Theory of the method of measurement of the viscosity of liquids by blowing-off the liquid layer in a narrow wedge-shaped slit. KUSSAKOV, M. *Acta PhysChim. URSS*, **20**, 47 (1945).—Based on the solution of the problem of laminary flow of a viscous fluid through a capillary, the cross-section of which is a sector of a circle, a more precise representation is given of the hydrodynamic principles of the blow-off method for the case of a narrow wedge-shaped slit. [Abstr. 35 (1947)]. The accuracy with which the "blow-off force" (for small apex angles of the wedge) can be considered proportional to the distance from the slit edge is determined. A.

532.517 : 539.214.9 = 82 221

Flow of a plastic-viscous body between two parallel plane walls and in the annular space between two coaxial pipes. VOLAROVICH, M. P., AND GUTKIN, A. M. *J. Tech. Phys., USSR*, **16** (*No.* 3) 321–8 (1946) *In Russian.*—The Bingham differential equation describing the flow of a plastic viscous body for tubes of circular section can be extended to tubes of rectangular section by assuming one side of the rectangle to be several times greater than the other. The problem is thus considered as that of the flow of a plastic mass between two parallel plane walls (plane capillary). Practical application occurred in the peat-drying process. An analogous problem, arising in the development of a new press, is represented by the flow of the plastic mass in the annular space of two coaxial pipes, which is here considered as an annular capillary. Equations are developed for the two cases, which are shown to be basically identical. R. M.

532.517 : 539.501 *see Abstr.* 433

532.517.3 222

Fluid motion between parallel planes. Dynamical stability. MEKSYN, D. *Proc. Roy. Soc. A*, **186** (*No.* 1006) 391–409 (*Sept.* 24, 1946).—The equations of motion lead to a 4th order differential equation containing a large parameter. This has two slowly varying, non-viscous integrals and two rapidly varying, viscous integrals. The solutions are used to obtain these results, U being the velocity of the mean motion: (1) The region where U is equal to the wave velocity is the source where vibrations are generated; slowly varying vibrations give rise to large, rapidly varying vibrations in passing through the critical point. (2) Curved profiles admit a periodic motion

at very high Reynolds numbers. (3) Parabolic flow is unstable at high Reynolds numbers. The critical Reynolds number is $R = U_0 h/\nu = 6\,700$, and the corresponding wavelength is about 3× the width of the channel. Here U_0 is the mean velocity at the axis, and h is the ½-width of the channel. L. S. G.

532.517.3 223

Stability of viscous flow between rotating cylinders. I. MEKSYN, D. *Proc. Roy. Soc. A*, **187**, 115–28 (*Oct.* 8, 1946).—The equations of motion are integrated by deriving asymptotic expansions for the velocities, in terms of a large parameter, λ. Only the case where the cylinders rotate in the same direction is considered. The final formulae are simple and Taylor's conclusions [Abstr. 1518 (1923), 68 (1937)] are confirmed. In the case of instability, if the angular velocities Ω_1 and Ω_2 are proportional to $\cos \lambda z \,.\, e^{\sigma t}$, then λ approximately satisfies $\lambda d = \pi$, where d is the distance between the cylinders. It is shown that if Ω_1 is fixed there is only a limited number of possible wavelengths, and probably only a single wavelength can be observed. There are no solutions when σ is complex. L. S. G.

532.517.4 224

The theory of axisymmetric turbulence. BATCHELOR, G. K. *Proc. Roy. Soc. A*, **186** (*No.* 1007) 480–502 (*Sept.* 24, 1946).—An invariant theory [Abstr. 1397 (1940)] is developed. The form of the fundamental velocity correlation is obtained and scales of axisymmetric turbulence are defined. Equations are established giving the rates of change of the mean squares of the velocity components, involving two terms. The first represents viscous dissipation, the second a transfer of energy from one component to the other. This is due to the finite correlation between the velocity and pressure at neighbouring points. The effects of this correlation and of this viscous dissipation on the two velocity components are examined, and expressions are obtained for the rates of change of the mean squares of the vorticity components. L. S. G.

532.528 225

On the destructive action of cavitation. KORNFELD, M., AND SUVOROV, L. *J. Phys., USSR*, **8** (*No.* 3) 171–81 (1944).—Using a Gaines oscillator [Abstr. 678 (1933)] experiments were made to follow the process of formation and subsequent collapse of cavities. Radial and surface vibrations of air bubbles are analysed and the instability of vibrating bubbles is discussed. The results are useful in an attempt to understand the destructive action of cavities and have application to the design of ships' propellers, where such destruction is of importance. L. S. G.

532.582.3 226

The drag of cylinders in fluids at slow speeds. WHITE, C. M. *Proc. Roy. Soc. A*, **186** (*No.* 1007) 472–9 (*Sept.* 24, 1946).—Experiments were made with Cu wires falling sideways in glycerine solutions of various viscosities. When the speed, s, is very small the resistance is independent of the density of the fluid when this is finite in extent. The motion is purely viscous and the boundary distance controls the pattern; Reynolds number is unimportant. When s is greater, the resistance is independent of the distance and agrees with Lamb's formulae for a cylinder in an infinite fluid. The experiments cover a range of Reynolds numbers from 10^{-5} to 100. At a low speed the influence of distant boundaries is great and Lamb's formulae is not applicable, e.g. when the Reynolds number is 10^{-4} the presence of boundaries 500 diameters away doubles the drag. L. S. G.

532.59 : 534.222.2 227

A spark shadowgraphic study of body waves in water. MCMILLEN, J. H., AND HARVEY, E. N. *J. Appl. Phys.*, **17**, 541–55 (*July*, 1946).—The waves were formed by high-velocity missiles striking the water surface and were photographed with sparks of $<10^{-7}$ sec duration. The wave fronts were slightly elliptical. Secondary waves observed behind the impact wave were due to the vibration of the missile, and the periods of vibration determined from their spacing for spheres of several diameters agreed within 20% with those calculated on Lamb's theory. The shape of the cavity behind the missile was investigated, and the pressure gradients surrounding the missile were measured from the distortion of the shadowgram of a grid placed in front of the tank. Reflection of the waves under various conditions was studied; phase reversal occurred on normal reflection from surfaces of lower acoustic impedance, and at glancing incidence even for higher impedance surfaces. Striations 0·02 to 0·08 cm apart were often observed when waves were reflected, and are believed to be formed by the passage of the reflected through the incident waves. A.

532.59 : 629.1 : 534.12 = 82 *see Abstr.* 241

532.592 228

Note on waves on the surface of running water. DEAN, W. R. *Proc. Camb. Phil. Soc.*, **43**, 96–9 (*Jan.*, 1947).

532.593 229

Motion of waves in shallow water. Interaction between waves and sand bottoms. BAGNOLD, R. A. *Proc. Roy. Soc. A*, **187**, 1–15 (*Oct.* 8, 1946).—A travelling water wave loses energy through the formation of sand ripples and water vortices on a sandy bed, and this is important when models are used to predict full-scale foreshore movements. Experiments were made to obtain quantitative data (*a*) on the size and character of the sand ripples, (*b*) on the drag to which these ripples give rise, and (*c*) on the minimum oscillating water motion required to disturb the sand. A section of the bed was oscillated harmonically through still water with these results: (1) The pitch, p, of the sand ripple varies as the square root of the grain diameter, and is independent of the speed and of the grain density for amplitudes, R, of water motion exceeding the pitch. (2) The mean drag coefficient, R_f remains constant for $R < p$, but varies as $(R/p)^{-0.75}$ for $R > p$. The critical water speeds and amplitudes for first disturbance of grains on a smoothed surface were measured over a wide range of grain diameters and densities. A simple accurate empirical formulae for the critical angular speed is obtained. L. S. G.

532.593 230

Note on R. A. Bagnold's empirical formula for critical water motion corresponding with the first disturbance of grains on a flat surface. TAYLOR, G. I.

Proc. Roy. Soc. A, **187**, 16–18 (*Oct.* 8, 1946).—A theoretical formula is deduced and compared with the empirical formula [Abstr. 229 (1947)], and a rough calculation is made of the critical value of the rate of shear at which grains might be expected to begin to roll. L. S. G.

532.593 : 551.465 231

Wave energy: sideways flow and losses by the shore. UNNA, P. J. H. *Nature, Lond.*, **158**, 635–6 (*Nov.* 2, 1946).—Sea waves entering a channel at once start to spend some of their energy along the shores, resulting in a sideways flow of energy, and attenuation of the waves. The relation between width of channel and rate of attenuation is discussed, and the English Channel taken as an example.

532.594 232

Waves on the surface of a compressible liquid. BONDI, H. *Proc. Camb. Phil. Soc.*, **43**, 75–95 (*Jan.*, 1947).—The possibility of the propagation of disturbances along a free surface with a velocity exceeding the velocity of sound in the liquid is examined. Simple necessary conditions are found in terms of the boundary condition. It is shown that they are not satisfied in the case of gravity waves, and a detailed examination is made of the pressure and surface waves due to a localized disturbance. Capillary waves are shown to satisfy the conditions for ultrasonic propagation, the existence of a "faster-than-sound" wave is proved, and its main properties are examined. A.

CAPILLARITY 532.6

532.61 : 536.49 = 82 233

The relation between the surface tension and temperature of amorphous bodies. FRENKEL, I., AND GUBANOV, A. *J. Exp. Theor. Phys.*, **16** (*No.* 5) 435–50 (1946) *In Russian.*—The relation is based upon an analysis of the motion in solid and liquid bodies having a free boundary surface [Abstr. 235 (1947)]. For liquefied gases and benzene the relation is determined mainly by thermal expansion, and in other cases by a change in entropy.

532.694 : 536.423.1 : 541.182.2 234

The influence of spray particle size and distribution in the combustion of oil droplets. PROBERT, R. P. *Phil. Mag.*, **37**, 94–105 (*Feb.*, 1946).—The size distribution in a spray follows the law $R = \exp[-(x/\bar{x})^n]$ where R is the volume of spray consisting of drops whose diameter exceeds x, and $\bar{x}$ and n are constants. This, together with an experimental law on the effect of size on evaporation, is used to evaluate the mean diameter and rate of evaporation of given distributions, as the evaporation proceeds. The rate depends much more sensitively on $\bar{x}$ than on n, and a liquid fuel spray should have a small value of $\bar{x}$ and a large value of n, even though the latter gives a slower initial rate of evaporation of the injected spray. Graphs are given which show how the liquid volume of a spray varies with time. L. S. G.

532.696.1 : 539.61 = 82 *see Abstr.* 434

KINETIC THEORY OF LIQUIDS 532.7

532.7 : 534.131 = 82 235

Thermal motion in a spherical body, taking into account the surface effect. (A contribution to Debye's theory.) GUBANOV, A. *J. Exp. Theor. Phys.*, **16** (*No.* 5) 423–34 (1946) *In Russian.*—The number of vibrations of a sphere is calculated by Debye's method. The boundary conditions assumed are that the surface stresses of the sphere are zero, and not the surface displacements as assumed by Debye. The solution of this problem has been used for the determination of the temperature variation of surface tension [see Abstr. 233 (1947)]. A.

MECHANICS OF GASES 533

533.15 : 536.423.1 *see Abstr.* 320

533.5 236

A mass spectrometer type of leak detector. THOMAS, H. A., WILLIAMS, T. W., AND HIPPLE, J. A. *Rev. Sci. Instrum.*, **17**, 368–72 (*Oct.*, 1946).—The instrument described measures one part of He in 400 000 parts of other gases. The instrument is built around a 180°-type mass spectrometer tube which is prefocused for He ions. Use is made of this high sensitivity tube to locate leaks in vacuum equipment which can be connected and evacuated by the pumps in the unit. A fine stream of He played over the surface will enter the leak and register immediately on the output meter. Very small leaks can be located easily to within $\frac{1}{4}$ in.

533.6.011 237

The two-dimensional hydrodynamical theory of moving aerofoils. IV. MORRIS, R. M. *Proc. Roy. Soc. A*, **188** (*No.* 1015) 439–63 (1947).—Some adjustments are made in formulae of previous papers [Abstr. 3526 (1939)]. The results are then applied to a general discussion of the stability problem, including the effect of the trailing wake. To a first approximation the wake, as usually assumed, has little or no effect on the reality of the roots of the period equation, but it may introduce instability of the oscillations, if the centre of gravity of the element is not sufficiently far forward. An Appendix contains results on the motion of a vortex behind a moving cylinder. A.

KINETIC THEORY OF GASES 533.7

533.72 : 519.213 238

The probability of encounters between gas molecules. RICHARDSON, L. F. *Proc. Roy. Soc. A*, **186** (*No.* 1007) 422–31 (*Sept.* 24, 1946).—Two new methods are given for calculating the occurrence of binary, ternary, etc., encounters. (1) The close analogy between gases and emulsions is related to the experiments of Gosset on the distribution of the square cells of a haemacytometer with respect to the number of particles they contain. It is found that in 1 cm³ containing n molecules, the number of simultaneously existing encounters of 2, 3 or 4 molecules

is $\frac{1}{2}n^2\omega_1 e^{-n\omega_1}$, $\frac{1}{6}n^3\omega_1^2 e^{-n\omega_1}$ or $\frac{1}{24}n^4\omega_1^3 e^{-n\omega_1}$, where ω_1 is a constant of the order of 10^{-22} cm³. (2) A statistical analysis is made to find the aggregate duration of binary encounters between unlike molecules in a mixture consisting of n_1 molecules of one species and n_2 of another. In specifying a binary encounter it is necessary to express the fact that 2 molecules must meet and also that a large number must not meet the pair. The latter leads to exponential factors in the expressions for the probability.

L. S. G.

VIBRATIONS . ACOUSTICS 534

534.01 = 4 239

On the conditions for stability in oscillatory systems. COUFFIGNAL, L. *Rev. Sci., Paris*, **83**, 195–211 (*March*, 1945) *In French.*—Stability is guaranteed if the real parts of the roots of a certain algebraic equation are negative. The Routh–Hurwitz conditions for this are replaced by conditions which are simpler to apply in practice. Certain "polynomials of stability" are introduced and used to set up a criterion for stability. A general method for evaluating these polynomials is described and the conditions for stability are expressed simply for systems with 2, 3 or 4 degrees of freedom. Some geometrical ideas are valuable in an interpretation of the conditions and a nomogram is given which quickly enables the conditions to be applied in a particular case. L. S. G.

534.014.2 240

An experimental investigation of forced vibrations in a mechanical system having a non-linear restoring force. LUDEKE, C. A. *J. Appl. Phys.*, **17**, 603–9 (*July*, 1946).—A mechanical apparatus was used for generating and recording forced vibrations in a system having a non-linear restoring force. The experimental wave forms were compared with the theoretical results given by three graphical methods. In all experimental results it was noted that even though the restoring force was distinctly non-linear, the wave forms of the resulting motion were nearly sinusoidal as long as the frequency of the observed motion was the same as the frequency of the disturbing force. However, steady oscillations could be maintained for which the observed frequency was a sub-multiple of the disturbing frequency. Two such subharmonics were recorded and the experimental wave forms are shown. A.

534.12 : 532.59 : 629.1 = 82 241

Deformation of an ice layer under travelling loads. IVANOV, K. E., KOBEKO, P. P., AND CHULJMAN, A. R. *J. Tech. Phys., USSR*, **16** (*No.* 3) 257–62 (1946) *In Russian.*—Vibrations in the ice layer with the passage of motor vehicles were investigated on Lake Ladoga, the Neva and Lake Suzdal. Deformation measurements carried out by means of Reynov yield recorders provided continuous records of displacement of the ice layer relative to the bed over a wide area. For vehicle speeds of 5 to 15 km/hr, simple elastic deformation was observed, the disturbance advancing and retreating along the ice at the vehicle speed. The yield in this case was $\frac{2}{3}$ to $\frac{1}{2}$ of that for static loading. At vehicle speeds above 20 km/hr, a wave vibration was initiated in the ice, extending over a distance of hundreds of metres; for an ice thickness of 60 cm and water depth 5 m, the wavelength was 200 m and speed of propagation $v \simeq 35$ km/hr, independent of vehicle speed and weight. This speed is roughly $\frac{1}{100}$th that of acoustic waves in ice, and is nearer that of travelling waves in water, as calculated from the Lagrange formula (25 km/hr). Vibrations in the ice layer are presumably caused by the hydrodynamic wave, the deviation from the Lagrange formula being a function of the ice layer. The formula relating speed of propagation of the waves under ice, with modulus of elasticity (E), ice thickness (d) and water depth (H) is given as:

$$v = \sqrt{\left\{gH\left(1 + \frac{\pi^4 E d^3}{24\gamma l^4}\right)\right\}}$$

where γ is the weight of the liquid per unit volume. An analysis of load conditions provides recommendations for the regulation of traffic over the ice crust. R. M.

534.121.1 : 534.232 *see Abstr.* 255

534.131 : 532.7 = 82 *see Abstr.* 235

534.15 : 534.372 : 621–752 : 621.317.39 242

The analysis of vibration problems. KING, A. J. *J. Instn Elect. Engrs, Pt II*, **93**, 435–62 (*Oct.*, 1946).—[Abstr. 87 B (1947)].

534.21 243

Theory of the propagation of sound in scattering and absorbing media. GIVENS, M. P., NYBORG, W. L., AND SCHILLING, H. K. *J. Acoust. Soc. Amer.*, **18**, 284–95 (*Oct.*, 1946).—The theory predicts that curves of physical transmission loss against distance should be convex upward if the sound is detected by means of a directional microphone directed toward the source, and concave upward if perpendicular to a line from the source. The theory also predicts the directionality of sound in the medium, and is applied to transmission through forests and through open air containing inhomogeneities. A.

534.213 244

Propagation of plane sound waves in rarefied gases. TSIEN, H., AND SCHAMBERG, R. *J. Acoust. Soc. Amer.*, **18**, 334–41 (*Oct.*, 1946).—If the density of gas is very small, the conventional Navier–Stokes equations are not accurate enough. The present investigation includes the effect of the so-called third approximation to the solution of the Boltzmann–Maxwell equation, and the results show that, even under extreme conditions, the velocity of propagation deviates from its usual value by only 2%. A.

534.213 : 534.26 245

Theory of propagation of sound in a half-space of variable sound velocity under conditions of formation of a shadow zone. PEKERIS, C. L. *J. Acoust. Soc. Amer.*, **18**, 295–315 (*Oct.*, 1946).—In the case of sound emanating from a source some distance below the surface of a medium in which sound velocity decreases with depth, there is a shadow zone into which no rays penetrate. This paper consists of a theoretical study of the diffracted radiation penetrating into the shadow zone. The intensity falls off essentially exponentially with distance from the shadow boundary, but there exists for each point a frequency of optimum penetration. Travel times for

the disturbance are calculated, and the method of computing the pressure-time curve for pulses indicated. Constant and depth-varying velocity gradients are treated. A.

534.213 : 535.31 *see Abstr.* 275

534.213.4 = 4 246

Discontinuities in pipes. GUITTARD, J. *Ann. Phys., Paris*, **1**, 142–89 (*March–April*, 1946) *In French.*—Consideration is given to the effect of a discontinuity, an opening or an obstacle, in the body of a resonating air column. The discontinuities take the form of an opening in the side of the tube communicating with a volume, either infinite (atmosphere) or finite (a branching tube of T or Y form). The various phenomena relating to phase and amplitude near the discontinuity are studied by means of manometric capsules (with reflecting mirror) or by means of fine powder (amidon) which when suitably illuminated reveals the nature of the displacement of the air in the tube. Similar observations are made of the motion of the air in the vicinity of small obstacles inserted in the vibrating column of air in the tube.

A. B. W.

534.222 : 550.341 = 5 *see Abstr.* 478

534.222.1 247

Ray computation for non-uniform fields. SABY, J. S., AND NYBORG, W. L. *J. Acoust. Soc. Amer.*, **18**, 316–22 (*Oct.*, 1946).—A formula is derived which simplifies computation. A field is first assumed to be equivalent to an array of horizontally homogeneous strata each with a uniform gradient of the speed of sound, and the "range" of the ray through the whole array can be computed in one step, to an adequate degree of approximation considered. Special problems encountered in applying the formula under certain types of conditions are discussed. The method is particularly useful in the study of the propagation of ultrasonic waves through the atmosphere near the ground, where micrometeorological conditions often produce rather complicated gradient conditions. A.

534.222.1 248

The propagation of sound in an inhomogeneous and moving medium I. BLOKHINTZEV, D. *J. Acoust. Soc. Amer.*, **18**, 322–8 (*Oct.*, 1946).—The wave equations are established, and special cases are considered. A generalization of Kirchhoff's theorem (Huygens' principle) is given for a moving medium. The general equations of acoustics are considered in the approximation of geometrical acoustics, and, finally, the equations are generalized for the case of a medium containing a salt solution (sea water). A.

534.222.1 249

The propagation of sound in an inhomogeneous and moving medium II. BLOKHINTZEV, D. *J. Acoust. Soc. Amer.*, **18**, 329–34 (*Oct.*, 1946).—Several applications of the theory developed in I are set forth, e.g. the propagation of sound in a turbulent medium, and propagation through a shock wave. A.

534.222.2 250

Shock waves in gases at the detonation of brisant explosives. JOHANSSON, C. H. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 2) *Paper* 13, 23 *pp.* (1946).—A paper, mainly theoretical, which deals with the propagation of waves of detonation through gases. The detonation of an explosive involves its conversion into a heated mass of gas at high pressure, the temperature and pressure being of the order of 3 000°C and 10^5 atmospheres. At the instant of detonation the boundary surface has a velocity of the order of 10^4 m/sec. The state of the compression layer in the surrounding gas has been calculated on the assumption of an "ideal" gas—an assumption which appears to lead to correct results. Dissociation of atmospheric air is noticeable when the boundary velocity exceeds about 3 000 m/sec, and because of the energy thus consumed, the temperature increases rather slowly with the velocity up to 8 000 m/sec where the dissociation is nearly complete. Further investigation proves that about half the work conveyed to the compression layer is consumed to give kinetic energy to the gas and the other half to increase the internal energy of the gas. A discussion follows on the velocity of propagation of the shock wave. For a detonation, the normal velocity of sound is a lower limit to which is added a translational term owing to the expansion of the explosion. The translationa term dominates near the origin of the explosion, whilst at greater distances the normal velocity of sound dominates. A. B. W.

534.222.2 251

The air wave surrounding an expanding sphere. TAYLOR, G. I. *Proc. Roy. Soc. A*, **186** (*No.* 1006) 273–92 (*Sept.* 24, 1946).—The radial outward flow produced by a uniformly expanding sphere is examined mathematically. The differential equations governing the flow are solved numerically, and the distributions of velocity and pressure are calculated for a range of rates of expansion. The region of expanding air is bounded by a shock wave outside which the air is undisturbed. As the radial velocity of the sphere increases the thickness of the layer of disturbed air decreases till at infinite rate of expansion it is only 6% of the radius of the sphere. L. S. G.

534.222.2 252

Explosion waves and shock waves. VI. The disturbance produced by bursting diaphragms with compressed air. PAYMAN, W., AND SHEPHERD, W. C. F. *Proc. Roy. Soc. A*, **186** (*No.* 1006) 293–321 (*Sept.* 24, 1946).—An investigation is made of the development of the disturbance set up in a uniform tube when a body of compressed gas, confined at one end by a copper diaphragm, is released by rupture of the diaphragm. The wave-speed camera [Abstr. 3695 (1931)] gives continuous Schlieren records of the passage of the effects along the tube. The pressure effects are a shock wave, a vortex formation and the expanding gases from behind the diaphragm. Photographs are obtained showing the structure of these effects when they are projected from the end of the tube into free air. A system of stationary sound waves is established. The experiments were carried out with various thicknesses of diaphragm, lengths of compression and expansion chambers, and various gases in the chambers. L. S. G.

534.222.2 : 531.787 *see Abstr.* 217

534.222.2 : 532.59 *see Abstr.* 227

534.231.3 : 621.3.011.1 253

Violation of the reciprocity theorem in linear passive electromechanical systems. MCMILLAN, E. M. *J. Acoust. Soc. Amer.*, **18**, 344–7 (*Oct.*, 1946).—

A simple energy argument is used to show that the theorem of reciprocity is not necessarily valid for linear passive electromechanical systems. It is found that in the case of crystal or electrostatic transducers the theorem is satisfied, while in the case of magnetic or electrodynamic transducers it is satisfied in magnitude but not in sign. It is further shown that by combining the two types of transducers, systems can be constructed that violate reciprocity in magnitude. A.

534.232 254

A fifty horsepower siren. JONES, R. C. *J. Acoust. Soc. Amer.*, **18**, 371–87 (*Oct.*, 1946).—This paper contains a description of the theory, construction and testing of a siren of the traditional type with an acoustic output of 50 horsepower, efficiency 70%. The theory is developed with the aid of an equivalent circuit diagram in which the various acoustic impedances are represented as lumped circuit elements; the non-linear nature of the impedance of the port is taken into account. The siren was constructed to operate with a compressor supplying 2 500 ft³ of air/min at a pressure of 5 lb/in², and contains six ports with a total area of 22 in², opened and closed by a rotary chopper at a frequency of about 500 c/s. Each of the ports is provided with an exponential horn of cut-off frequency 125 c/s. The measured level at 100 ft is 138 db, at the mouth of the horns is 174 db above 10^{-16} W/cm², and the calculated level in the throat of the horns is 184 db (i.e. 260 W/cm²). A.

534.232 : 534.121.1 255

The directional characteristics of a free-edge disk mounted in a flat baffle or in a parabolic horn. SLAYMAKER, F. H., MEEKER, W. F., AND MERRILL, L. L. *J. Acoust. Soc. Amer.*, **18**, 355–70 (*Oct.*, 1946).—To obtain a sharp supersonic beam with a parabolic horn, it was found desirable for the diaphragm feeding the horn to radiate most of its energy towards the walls of the horn rather than the mouth. This was done most effectively by a diaphragm vibrating with two concentric circular nodes. An analysis is given of the vibration conditions and radiation diagrams of free-edge diaphragms with one, two or three circular nodes, and disc diameters and thicknesses can be calculated to give any desired pattern at any frequency. Following these calculations, a one-circle node diaphragm was made which gave a satisfactory directional diagram.

534.241 : 531.719.35 = 82 256

The nature of under-sea echo. ANASTASEVICH, V. S. *J. Tech. Phys., USSR*, **16** (*No.* 3) 371–3 (1946) *In Russian.*—Under-sea echo ordinarily arises from the diffused reflection of acoustic waves from irregular surfaces. Special considerations enter into the problem in the case of echo from a large regular surface (e.g. a ship's hull) when the dimensions are comparable or large compared with the wavelength. Experimental data are applied to this case and it is shown that: (1) Duration of the echo depends both on the duration of the signal and length of the interfering object along the path of the signal, namely, $t_{echo} \simeq t_{tr} - \Delta x/v$ (t_{echo} = duration of echo; t_{tr} = length of signal; x = length of object; v = velocity of sound in the sea). (2) After transmission of the signal, loud and prolonged reverberation is observed, increasing in amplitude with duration of signal. (3) Echo is heard against the background of reverberation, i.e. reverberation is obtained both prior to and after the echo. (4) The distance at which the signal can be received is several times greater than the distance at which echo is received from the vessel. R. M.

534.26 257

The diffraction of sound pulses. I. Diffraction by a semi-infinite plane. FRIEDLANDER, F. G. *Proc. Roy. Soc. A*, **186** (*No.* 1006) 322–44 (*Sept.* 24, 1946).—A sound pulse is diffracted by an infinite wall with a straight edge. The motion is 2-dimensional and the wave-front of the incident pulse is parallel to the wall. The changes undergone by the pulse in diffraction are calculated for the pulse, $p_0 = (1 - z)e^{-z}$, in which the pressure rises instantaneously and then decays exponentially. The pressure changes in the geometrical shadow and near its boundary are studied and also the pressure at points on the wall itself. The initial pressure discontinuity along the boundary of the shadow is propagated as an instantaneous pressure discontinuity across the boundary. The mathematical method used consists in expressing the velocity potential in terms of the solution of a certain integral equation, which is solved after a transformation into Abel's integral equation. It is an improvement on the method of applying a Fourier transform to Sommerfeld's well-known solution of the diffraction of simple harmonic waves by a straight edge. L. S. G.

534.26 258

The diffraction of sound pulses. II. Diffraction by an infinite wedge. FRIEDLANDER, F. G. *Proc. Roy. Soc. A*, **186** (*No.* 1006) 344–51 (*Sept.* 24, 1946).—Sommerfeld's general solution is used as a basis for numerical calculations of the diffraction effects, in the case of rectangular incident pulses and the pulse considered in I [Abstr. 257 (1947)]. The pressure at the summit of a wedge is found to be greater than that of the incident pulse, but it dies down in the shadow. The diffracted pressure-time curves are similar to those obtained in the case of a half-plane. [See Abstr. 185 (1947)]. L. S. G.

534.26 259

The diffraction of sound pulses. IV. On a paradox in the theory of reflexion. FRIEDLANDER, F. G. *Proc. Roy. Soc. A*, **186** (*No.* 1006) 356–67 (*Sept.* 24, 1946).—A plane sound wave is reflected by an infinite plane reflector, and the "simple" theory indicates that the pressure at the reflector is double that of the incident wave, irrespective of the angle of incidence, θ. As $\theta \to 90°$ the doubling persists; but there is no reflection and there should be no doubling of the pressure. To explain this paradox the simple theory is abandoned. The reflection of sound pulses by a semi-infinite screen is examined in detail and it is shown that as $\theta \to 90°$ the diffracted pulse which emanates from the edge of the screen must also be considered, so that the region in which the simple approximate theory holds moves away from the edge. In the limit, the simple theory must be abandoned at all points at a finite distance from the edge. Reflection of sound pulses by infinite wedges is also considered. L. S. G.

534.26 : 517.65 *see Abstr.* 185

534.26 : 534.213 *see Abstr.* 245

534.321.9 : 534.62 260

Ultrasonic absorption in copper acetate and ethyl acetate. Beyer, R. T., and Smith, M. C. *J. Acoust. Soc. Amer.*, **18**, 424–8 (*Oct.*, 1946).—Measurements were made using the balance method for intensity measurement, and in neither case was the theoretical variation with (frequency)^2 observed, the relation being more nearly linear between 5 and 20 Mc/s. No transition to the theoretical relation at higher frequencies was observed. The absorption of very dilute solutions of Cu acetate increases rapidly with the concentration. A.

534.321.9 : 534.8 *see Abstr.* 270

534.322.1 261

Analyses of the tones of a few wind instruments. Saunders, F. A. *J. Acoust. Soc. Amer.*, **18**, 395–401 (*Oct.*, 1946).

534.372 : 621–752 : 621.317.39 : 534.15 *see Abstr.* 242

534.441.1/.2 262

The sound spectrograph. Koenig, W., Dunn, H. K., and Lacy, L. Y. *J. Acoust. Soc. Amer.*, **18**, 19–49 (*July*, 1946).—A brief analysis is given of possible methods of recording and analysing sounds which vary rapidly in frequency and amplitude. In some of these, 3-dimensional models are built up of oscillograms of overlapping frequency bands. The most recent portable sound spectrograph records signals on a vicalloy magnetic tape, and amplifies them to a voltage where they will directly mark indicating paper moving at 16 in/sec (70–300 V). Ordinates indicate frequency, and intensity of blackening indicates amplitude. Intensity range is limited to 12 db, or 30–40 db with compression. The differences between normal speech, monotone and whispering are immediately visible on the records. Spectrograms are shown for a wide variety of sounds. A. B. W.

534.612.4 263

On the absolute pressure calibration of condenser microphones by the reciprocity method. DiMattia, A. L., and Wiener, F. M. *J. Acoust. Soc. Amer.*, **18**, 341–4 (*Oct.*, 1946).—The technique has been perfected and standardized. Numerical data are given for a Western Electric Type 640-AA instrument which was calibrated at three laboratories in succession, showing the accuracy to be expected at the present state of the art. A.

534.62 : 534.321.9 *see Abstr.* 260

534.75 264

The pressure distribution in the auditory canal in a progressive sound field. Wiener, F. M., and Ross, D. A. *J. Acoust. Soc. Amer.*, **18**, 401–8 (*Oct.*, 1946).—The sound pressure was determined experimentally on a number of subjects by insertion of a small flexible probe microphone at various positions along the auditory canal. The sound pressure at the eardrum was found to be greater than the free-field pressure, the average ratio being a function of frequency, reaching values of about 20 db in the vicinity of 3 000 c/s. The human ear is thus an effective acoustic "amplifier." The increase in pressure is caused by a combination effect of diffraction by the head and pinna and resonance in the auditory canal. A.

534.77 : 612.85 265

Physics and physiology of acoustic trauma. Rüedi, L., and Furrer, W. *J. Acoust Soc. Amer.*, **18**, 409–12 (*Oct.*, 1946).—Acoustic strains that are physically quite different always produce similar functional damage to the ear. The well-known so-called "4 000 c/s dip" depends on a functional peculiarity of the cochlea. A universally efficient ear defender which does not essentially impair the auditory capacity, based on these facts, is described. A.

534.771 266

Effects of ear protective devices on the intelligibility of speech in noise. Kryter, K. D. *J. Acoust. Soc. Amer.*, **18**, 413–17 (*Oct.*, 1946).

534.771 267

The masking of speech by sine waves, square waves, and regular and modulated pulses. Stevens, S. S., Miller, J., and Truscott, I. *J. Acoust. Soc. Amer.*, **18**, 418–24 (*Oct.*, 1946).—The ability of three standard wave forms to mask speech, by raising its threshold of perceptibility, was measured as a function of the intensity and frequency of the masking signal, and results are given. Optimal masking is produced when the fundamental frequency lies in the range 100–500 c/s. Pulses of 10 μsec duration are most effective at a repetition frequency of about 200 p.p.s. When the time interval between successive pulses is made irregular (random interval-modulation), their ability to mask speech is dramatically increased. The increase in masking is a function of the original repetition frequency, the rate of modulation (determined by the spectrum of the modulating voltage), and the range of modulation. By a proper adjustment of the parameters of its random interval-modulation the train of pulses can be made to sound like a band of white noise. A.

534.781 268

Basic phonetic principles of visible speech. Kopp, G. A., and Green, H. C. *J. Acoust. Soc. Amer.*, **18**, 74–89 (*July*, 1946).—Using the sound spectrograph developed by Koenig, Dunn and Lacy [Abstr. 262 (1947)], phonetic studies have been made of various forms of speech. Firstly, a study was made of the unique characteristics of individual sounds, vowels and consonants. A comparison was made of oral English spoken in different parts of the American continent. Visible patterns of the same words and sentences spoken by different individuals show that the similarities in diction are much more pronounced than the differences. In normal speech visual intelligibility varies directly with aural intelligibility. That visible speech (recorded) is legible has been proved on experimental training groups in learning to read the patterns. A deaf person can learn to read visible speech. His ability to use the telephone by substituting vision for hearing indicates that visual telephony for the deaf is a possibility. A. B. W.

534.8 269

Jungle acoustics. Eyring, C. F. *J. Acoust. Soc. Amer.*, **18**, 257–70 (*Oct.*, 1946).

534.8 : 534.321.9 270

Ultrasonic ambient noise in tropical jungles. Saby, J. S., and Thorpe, H. A. *J. Acoust. Soc. Amer.*, **18**, 271–3 (*Oct.*, 1946).

534.87 : 551.508.99 : 621.396.11 271

Reflection of sound signals in the troposphere. GILMAN, G. W., COXHEAD, H. B., AND WILLIS, F. H. *J. Acoust. Soc. Amer.*, **18,** 274–83 (*Oct.*, 1946).—Experiments directed toward the detection of non-homogeneities in the first few hundred feet of the atmosphere were carried out with a low power sonic "radar." The device has been named the *sodar*. Trains of a.f. sound waves were launched vertically upward from the ground, and echoes of sufficient magnitude to be displayed on an oscilloscope were found. Strong displays tended to accompany strong temperature inversions. During these periods, transmission on a microwave radio path along which the sodar was located tended to be disturbed by fading. In addition, relatively strong echoes were received when the atmosphere was in a state of considerable turbulence. There was a well-defined fine-weather diurnal characteristic. The strength of the echoes led to the conclusion that a more complicated distribution of boundaries than those measured by ordinary meteorological methods is required in the physical picture of the lower troposphere. A.

OPTICS . RADIATION . SPECTRA 535

535.14 272

On the relativistic second order Doppler effect. VAN DER ZIEL, A., AND DE GROOT, W. *Physica, 's Grav.*, **12,** 499–500 (*Oct.*, 1946).—The relativistic formula is derived by the application of the laws of conservation of momentum and of energy in their relativistic form to the quantum process of radiation.

535.14 : 530.145.65 *see Abstr.* 210

535.231.2 = 82 273

A "black body" for radio waves. MALOV, N. N. *J. Exp. Theor. Phys.*, **16** (*No.* 6) 495–8 (1946) *In Russian.*

535.231.2 : 536.462 274

Optical investigation of an atomic hydrogen flame. VAN DEN BOLD, H. J., AND SMIT, J. A. *Physica, 's Grav.*, **12,** 475–90 (*Oct.*, 1946).—The flame was investigated with a view to its use as a "black radiator" background for measurement of temperatures of discharge and other radiating gases by line reversal, in the region from 3 000 to 3 500°K. The measuring apparatus is described, and horizontal and vertical temperature distributions given in a table and diagrams. It is concluded that the population of the upper energy levels complies with Boltzmann's formula, and the flame can be used for spectral lines with energies ≤ 6 eV. A.

535.3 : 548.73 : 537.531 *see Abstr.* 354

535.31 : 534.213 275

Propagation of radiation in a medium with random inhomogeneities. BERGMANN, P. G. *Phys. Rev.*, **70,** 486–92 (*Oct.* 1 *and* 15, 1946).—By means of the methods of geometrical optics, approximate formulae are derived which correlate the statistical properties of the inhomogeneities of the transmitting medium with the fluctuations to be expected in the signal level of radiative energy. Through a further simplification of the formulae obtained, it is possible to predict the dependence of signal fluctuation on range without detailed knowledge of the statistical parameters of the "microstructure" of the transmitting medium. A.

535.313.2 276

Quantitative tests for off-axis parabolic mirrors. SCHULZ, L. G. *J. Opt. Soc. Amer.*, **36,** 588–94 (*Oct.*, 1946).

535.317 277

An extension of the lens-mirror system of Maksutov. WYNNE, C. C. *Nature, Lond.*, **158,** 583–4 (*Oct.* 26, 1946).—Two spherical-surfaced thick meniscus lenses are combined with a spherical mirror, one concave and the other convex to the mirror. [See Abstr. 1282 (1946)].

535.321 : 535.414 278

A direct method for determining the index of refraction of thin films. ROBERTSON, J. K., STEWART, R. W., AND LODGE, J. I. *Nature, Lond.*, **158,** 703–4 (*Nov.* 16, 1946).—The films had been deposited on glass plates by a low pressure discharge. A fringe system established by interference within the film is compared with a simultaneously established system between the upper surface and an adjacent silvered glass plate. The relative variation of the systems gives the refractive index relative to air.

535.323 = 82 279

Measurement of the refractive index of thin layers of aluminium oxide. FRIDLAND, R. M., AND DERIAGIN, B. G. *J. Tech. Phys., USSR*, **16** (*No.* 3) 365–70 (1946) *In Russian.*—Measurements of layers of thicknesses from 5 to 130 mμ were carried out by the Langmuir method. The layers were treated in two groups according to the method of preparation by heating or anodizing. Mean values of 1·9 were obtained for the first group and 1·6 for the second group. The difference is not explained, being related neither to layer thickness nor temperature of treatment. R. M.

535.323–15 = 4 280

Study of the dispersion of some glasses in the near infra-red (calculation of dispersion formulae). RAMADIER–DELBÈS, J. *Rev. Opt. (Théor. Instrum.)* **21,** 156–67 (1942) *In French.*—Data are obtained for four glasses ($n_D = 1{\cdot}7$–$1{\cdot}5$), as far as $2{\cdot}4\,\mu$, by means of a constant deviation mirror spectrometer, Wadsworth type. It is shown that knowledge of the constants for the visible region does not permit of extrapolation beyond $0{\cdot}9\,\mu$. A type of formula is suggested capable of representing the whole of the data available, visible and infra-red. A. H.

535.33 : 539.132 *see Abstr.* 403

535.33 : 539.156 : 523.72 *see Abstr.* 194

535.33.03 = 82 281

Light source for the spectral analysis of metalloids in solid bodies. LEVINTOV, I. I. *J. Tech. Phys., USSR*, **16** (*No.* 3) 361–4 (1946) *In Russian.*—A newly developed light source for the spectral analysis of elements difficult to excite is based on the principle of separating the processes of vaporization and excitation. The material to be analysed is vaporized in a d.c. or a.c. arc, and excitation is applied by the periodic passage, across the arc, of an impulse discharge from a 1 μF capacitor charged to 6 000 V. Exposure to the spectrograph is synchronized with the impulse. Sensitivity of determinations on Cl,

Br, I and S is as fine as 0·06%. The possibility of employing metalloids as reference elements in quantitative determinations is demonstrated. Comparison of the "steady arc" spectrum with the spark spectrum shows increased intensity of the lines of the electrode elements, together with a weakening of the air lines in the spectrum. R. M.

535.33.03 : 537.525.72 *see Abstr.* 352

535.33.03 : 621.318.572 : 621.316.75.078.4 282

Light integrating exposure switch for spectrographic analysis. CLAYTON, H. R. *J. Sci. Instrum.*, **23**, 233–4 (*Oct.*, 1946).—To obtain spectrograms of consistent density and to minimize personal error, an automatic exposing device has been developed. A pre-sparking period of fixed duration is followed by an exposure period during which the light emitted by the source is integrated until it reaches a pre-set value, when the source is automatically extinguished.

535.331 : 539.153 283

On the deep configurations of Ti I, Ti II, V II, V III. MANY, A. *Phys. Rev.*, **70**, 511–15 (*Oct. 1 and 15*, 1946).—The theoretical formulæ for $d^n s^2$, $d^{n+1}s$, d^{n+2} are compared with the experimental data of Ti II, V III, Ti I, V II. In Ti II and V II the agreement is considerably improved by taking into account the interactions between configurations. A.

535.332 : 535.417 *see Abstr.* 307

535.338.4–31 : 539.132 284

Perturbations in the ultraviolet band spectrum of P_2. MARAIS, E. J. *Phys. Rev.*, **70**, 499–510 (*Oct. 1 and 15*, 1946).—The emission spectrum of the ultraviolet band system of P_2 has been photographed in the orders of a 21 ft concave grating. Strong rotational perturbations were found in the $v' = 5$, 7, 8, and 9 vibrational levels of the upper electronic state. These perturbations were fully determined. It is shown that the vibrational perturbations of the bands which result from the $v' = 5$ level are caused by the rotational perturbations in this level. The following values were obtained for the equilibrium constants: $B'_e = 0{\cdot}2416_6$, $B''_e = 0{\cdot}3032_7$, $\alpha'_e = 0{\cdot}00165$, $\alpha''_e = 0{\cdot}00142$ cm^{-1}; $I'_e = 115{\cdot}84 \times 10^{-40}$, $I''_e = 92{\cdot}31 \times 10^{-40}$ g/cm^2; $r'_e = 2{\cdot}12 \times 10^{-8}$, $r''_e = 1{\cdot}893 \times 10^{-8}$ cm. A.

535.342.084.82 285

A simple cell for spectroscopic examination of volatile liquids. OETJEN, R. A., WARD, W. M., AND ROBINSON, J. A. *J. Opt. Soc. Amer.*, **36**, 615–16 (*Oct.*, 1946).

535.343–15 286

The absorption spectra of acetylene and ethylene crystals in the near infra-red region. RODNIKOVA, I. *J. Phys., USSR*, **10** (*No.* 3) 236–42 (1946).—The spectra were investigated at temperatures close to fusion, and for the liquid state. A large number of bands was found that had not previously been detected in the gaseous spectrum. The absorption spectra of the liquids and crystals coincide in the main parts. A.

535.343.2–15 : 548.7 : 549.211 287

The infra-red absorption spectrum of diamond. RAMANATHAN, K. G. *Proc. Indian Acad. Sci. A*, **24**, 150–61 (*July*, 1946).—The absorption spectra of three luminescent and one non-luminescent diamonds were investigated by a rock-salt spectrometer and radiomicrometer in the range 4·5 to 13 μ. The non-luminescent specimen is non-absorbing from 770–1 400 cm^{-1}, whereas the luminescent diamonds show a band in this region with a number of maxima identifiable with those of lattice and superlattice vibrations. The intensity of this band seems to be related to the type of fluorescence displayed by the diamond, being strongest with a weakly blue fluorescent diamond, rather weaker with a specimen exhibiting intense blue fluorescence, and weaker still with a yellow-blue fluorescent diamond. The results are explained on the basis of the crystal structure and symmetry of diamond in its various allotropic forms. Absorption peaks between 1 400 and 2 700 cm^{-1} are accounted for as octaves and combinations of lattice and superlattice which are allowed by the anharmonicity of the vibrations. The appearance of the superlattice frequencies in the 8 μ band is closely associated with the i.r. activity of the fundamental lattice vibrations and is a sort of resonance effect. W. R. A.

535.343.4–31 288

The near ultraviolet absorption spectrum of toluene vapor. GINSBURG, N., ROBERTSON, W. W., AND MATSEN, F. A. *J. Chem. Phys.*, **14**, 511–17 (*Sept.*, 1946).—A spectrum of 209 bands was observed with partial resolution of the fine structure. A tentative analysis is given based on ground state frequencies 514, 620, 785, 1 003, 1 012, 1 176 and 1 209, which correlate completely with Raman data; on excited state frequencies, 456, 528, 751, 932, 964 and 1 186; and on difference frequencies 59 and 178 cm^{-1}. Assuming C_{2v} symmetry, all frequencies below 1 300 cm^{-1} of symmetry class A_1 appear in $1 - 0$ transitions and with one exception in $0 - 1$ transitions. In addition, a vibrational frequency of symmetry class B_1, deriving from an $\varepsilon_g{}^+$ vibration in benzene, appeared strongly both in the ground and excited state. A.

535.343.4–31 289

On the ultraviolet absorption spectrum of ozone. EBERHARDT, W. H., AND SHAND, W., JR. *J. Chem. Phys.*, **14**, 525–30 (*Sept.*, 1946).—The absorption spectrum of ozone has been investigated in the near ultraviolet from λ3439 to 3 850 Å at two temperatures. The bands observed have been interpreted as arising in part from transitions from the vibrationless ground electronic state and in part from transitions from excited vibrational levels of the ground electronic state. The distinction between the two groups is based primarily on the relatively large temperature sensitivity of the intensity of the bands ascribed to transitions from excited vibrational states. A partial analysis gives strong support to the assignment of the frequency 1 043 cm^{-1} to a fundamental vibration of the molecule. Moreover, it appears quite unlikely that the frequency 710 cm^{-1} can be eliminated as one of the fundamental frequencies. No information concerning the third fundamental frequency was obtained. A.

535.345.6 290

The preparation of mixed thallium bromide-iodide for infra-red transmission. TUTTLE, O. F., AND EGLI, P. H. *J. Chem. Phys.*, **14**, 571 (*Sept.*, 1946).

535.361.1/.2 291

Transmission and reflection by a diffusing medium. BENFORD, F. *Gen. Elect. Rev.*, **49**, 46–52 (*Oct.*, 1946).—Diffuse radiation, in the infra-red, visible or ultra-violet, is incident upon a diffusing medium. Formulae are given for the transmission and reflection coefficients, for any number of media, and these are used to construct characteristic curves, which present the reflection and transmission as functions of the thickness. L. S. G.

535.371 292

Luminescence processes in zinc sulphide phosphors. GARLICK, G. F. J., AND GIBSON, A. F. *Nature, Lond.*, **158**, 704–5 (*Nov.* 16, 1946).—The authors disagree with Klasen's theories [Abstr. 2845, 3129 (1946)] on experimental grounds. They state that retrapping of electrons is usually a negligible process in Zn sulphide luminescence.

535.371 : 537.226.8 *see Abstr.* 333

535.371 : 549.211 293

The luminescence of diamond excited by X-radiation. RAMACHANDRAN, G. N. *Proc. Indian Accd. Sci. A*, **24**, 81–94 (*July*, 1946).—Whilst the colour and patterns of luminescence by X-radiation were the same as those produced by u.v. excitation, it was weaker and varied over a smaller range of intensities. Photometrically it was found that fluorescence intensity was proportional to the current through the X-ray tube and approximately proportional to the (voltage)^3. Soft X-rays are more effective in producing luminescence than hard X-rays. The luminescence spectrum of a brightly blue luminescent diamond is discussed in its relation to the absorption spectrum. Luminescence probably arises as a result of the production of ions by the photo-electrons ejected by the X-rays, and quantitative formulae have been developed to explain the experimental data. W. R. A.

535.371 : 549.211 294

Geometric patterns of fluorescence in diamond. RENDALL, G. R. *Proc. Indian Acad. Sci. A*, **24**, 168–75 (*July*, 1946).—The blue and yellow patterns of luminescence shown by 19 cleavage plates of diamond were photographed using appropriate filters and are reproduced with patterns of transparency of the same plates to 2 536 Hg radiation and their birefringence patterns. Comparison of these patterns has enabled correlations between luminescence, u.v. transparency, and birefringence to be perceived. These correlations have been interpreted with reference to the structure of the crystal. The patterns of the blue and yellow fluorescent types are often very different. W. R. A.

535.371 : 549.211 295

Luminescence as "forbidden" electronic transitions in diamond. RAMACHANDRAN, G. N., AND CHANDRASEKHARAN, V. *Proc. Indian Acad. Sci. A*, **24**, 176–81 (*July*, 1946).—It is argued that the doublet (centre 4 152 Å) which occurs in the spectrum of all fluorescing diamonds arises from "forbidden" transitions analogous to the forbidden ^3P–^1S transitions in the spectrum of C I. By analogous reasoning, fluorescence lines are to be expected at approximately 8 816 and 7 849 Å, analogous to the ^3P–^1D and ^1D–^1S transitions in C I, the former occurring in absorption and the latter forbidden in absorption but appearing in emission when the wavelength of the exciting radiation is less than 4 152 Å. A line has been found at 7 930 Å which satisfies the necessary conditions, but the absorption line could not be recorded because it lay beyond the limit of the sensitivity of the photographic plate. W. R. A.

535.371 : 549.211 296

Phosphorescence patterns in diamond. CHANDRASEKHARAN, V. *Proc. Indian Acad. Sci. A*, **24**, 182–6 (*July*, 1946).—Phosphorescence patterns in cleavage plates of diamond revealing the variations in intensity of phosphorescence in different portions of the same diamond have been recorded by contact photography. Yellow phosphorescence emission corresponds with blue fluorescence patterns, but yellow fluorescence patterns, if present, are not recorded in phosphorescence. Geometrical patterns, such as parallel bands, triangles, hexagons and spirals, have frequently been obtained. W. R. A.

535.371 : 549.211 297

The phosphorescence of diamond. CHANDRASEKHARAN, V. *Proc. Indian Acad. Sci. A*, **24**, 193–7 (*July*, 1946).—When fluorescent diamonds have been irradiated with u.v. light they retain energy, some of which is released as phosphorescence at room temperature, but most retained until the diamond has been illuminated with long wavelength radiations, when it is released as a flash of visible light. Light of wavelength greater than 4 200 Å removes activation, whilst light of wavelength less than 3 000 Å is most effective in producing activation. The effects are observable even at the temperature of liquid air. Phosphorescence can be removed by heating to 270°, when thermoluminescence is observed. Blue fluorescent diamonds emit their stored-up energy as a blue flash in which the 4 152 Å system is most prominent, whilst in green fluorescent diamonds green light is emitted and contains the 5 032 Å system. W. R. A.

535.371 : 621.327.43.004.6 298

Depreciation of fluorescent lamps without passage of current. FROELICH, H. C. *J. Appl. Phys.*, **17**, 573–9 (*July*, 1946).—Fluorescent lamps with thin and with partial coatings of phosphor on bulbs of u.v. transmitting glass were irradiated with Hg 2 537 radiation. Comparison with similar lamps which were burned showed a decline in lumen output which was of the same general character in all experiments, except for different time factors. This indicates that the process of lamp depreciation is fundamentally of photochemical nature, involving excited Hg, but not requiring either Hg ions or neutral atoms. It is assumed that superficial oxygen ions of the phosphor crystal react with Hg* to form links of the type SiO–O–Hg–Hg . . ., thus tying Hg to the crystal with a resulting loss of phosphor brightness. A.

535.375.5 299

The Raman spectrum of rock-salt. KRISHNAN, R. S. *Proc. Roy. Soc. A*, **187**, 188–96 (*Oct.* 22, 1946).—A study of the spectrum was made, using a non-luminescent crystal of rock-salt and the 2 536·5 Å resonance radiations of the Hg arc as exciter. There are 9 distinct Raman lines in the spectrum with frequency shifts 135, 184, 202, 235, 258, 278, 314, 323 and 350 cm^{-1}. The shifts 235 and 184 cm^{-1} agree with the position of the 2 subsidiary infra-red

absorption maxima observed with thin films of rock-salt [Abstr. 787 (1932)]. The nature of the spectrum is discussed on the basis of theories due to Tamm [Abstr. 2551 (1930)] and Fermi [Abstr. 456 (1932)], but the results are quite different from those observed experimentally. It is concluded that the Born lattice dynamics does not correctly represent the vibration spectrum of the rock-salt lattice; but the observations are in accordance with the dynamics of crystal lattices given by Raman [Abstr. 1877 (1944)]. L. S. G.

535.375.5 : 548.7 : 549.211 300

The second order Raman spectrum of diamond. KRISHNAN, R. S. *Proc. Indian Acad. Sci. A*, **24**, 25–32 (*July*, 1946).—The 2nd order Raman spectrum of an exceptionally colourless plate of u.v.-transparent diamond excited by the 2 536·5 Å Hg line consists of 10 distinct Raman lines with frequencies between 2 176 and 2 666 cm^{-1}, 5 of which correspond with the positions of 5 absorption peaks in the absorption band 4–4·8 μ. The more intense 2nd order lines have been identified as octaves of prominent lattice frequencies appearing in the luminescence and absorption spectra, and can be explained on the basis of the Raman dynamics of crystal lattices but not on the basis of the Born lattice dynamics. Relative intensities of the 2nd order lines and the ratios of the intensities of Stokes, the anti-Stokes and the octave of the principal Raman shift of 1 332 cm^{-1} have been estimated by photographic photometry. W. R. A.

535.375.5 : 548.7 : 549.211 301

Temperature variations of the Raman frequencies in diamond. KRISHNAN, R. S. *Proc. Indian Acad. Sci. A*, **24**, 45–57 (*July*, 1946).—The prominent Raman frequency of diamond has lower frequency at higher temperature, being 1 333·2 cm^{-1} at 85°K and 1 316·0 cm^{-1} at 975°K. The change of principal frequency relative to change of volume decreases from a high value at 85°K to a constant small value at temperatures above 500°K and differs greatly from the so-called Grüneisen constant. This line has a finite width which increases with temperature, a fact which is attributed to the changes of lattice frequency arising from thermal fluctuations of density in the volume elements of the crystal if the effective linear dimensions of a volume element are assumed to be approximately 8× as large as the edge of the unit cubic cell. The temperature dependence of the more prominent 2nd order frequencies has also been investigated. Different lattice and superlattice frequencies behave differently in respect of their temperature variations owing to differences in the rate of change with temperature of the different force constants which determine the vibration frequencies of the diamond lattice. W. R. A.

535.375.54 = 82 302

Some simple relations in the Raman spectra of similar crystals and the rotational oscillations of molecules. VUKS, M. *J. Exp. Theor. Phys.*, **16** (*No.* 5) 410–15 (1946) *In Russian*.—Raman spectra at low frequency are analysed for a group of isomorphous crystals. The importance of the symmetry of the molecules themselves is shown. A.

535.377 : 549.211 303

The thermoluminescence of diamond. CHANDRASEKHARAN, V. *Proc. Indian Acad. Sci. A*, **24**, 187–92 (*July*, 1946).—After irradiation with u.v. light, blue fluorescent diamonds, at room temperature, show a greenish-yellow glow which has a less persistent blue component. On heating to 270° the colour of the glow changes to blue and brightens, and this thermoluminescence can be produced even after several days from the time of irradiation. Unlike the activation of phosphorescence, radiations of less than 3 000 Å are more effective than those between 3 000 and 4 000 Å; and X-rays give slight activation. For green fluorescent diamonds the thermoluminescence is greenish-yellow and much fainter. Activation is removed by radiations of wavelength greater than 4 200 Å. W. R. A.

535.393 304

Reflectivity of nickel. WEIL, R. *Nature, Lond.*, **158**, 672 (*Nov.* 9, 1946).—The temperature coefficient in the visible range was found experimentally to be $+0{\cdot}85\times10^{-4}$ (red) to $+1{\cdot}6\times10^{-4}$ (red). No discontinuity occurred at the Curie point. To account for the sign of the coefficient, it is suggested that at these wavelengths the (negative) dielectric constant and its temperature variation has a preponderating influence on the reflectivity.

535.412 305

A note on Talbot's bands. SHOENBERG, D. *Proc. Camb. Phil. Soc.*, **43**, 130–3 (*Jan.*, 1947).—Although the explanation of Talbot's bands is well known, the theory does not usually go beyond deducing the condition for the bands to be most clearly visible. In the present note an expression is obtained for the visibility of the bands as a function of the experimental variables.

535.412 306

A note on white light fringes. SHOENBERG, D. *Proc. Camb. Phil. Soc.*, **43**, 134–6 (*Jan.*, 1947).—It is shown that the white light fringe obtained with Brewster's fringes or with "scatter" fringes has a breadth which decreases with the reflexion coefficient R of the film surfaces. The decrease of intensity from the centre of the fringe is given by the usual Fabry–Perot formula except that R is replaced by R^2. A.

535.414 : 535.321 *see Abstr.* 278

535.417 : 535.332 307

Krypton vacuum wavelength measurements. LITTLEFIELD, T. A. *Proc. Roy. Soc. A*, **187**, 220–8 (*Oct.* 22, 1946).—The wavelengths of 31 lines in the spectrum of Kr were compared directly with the red Cd standard using a reflecting echelon in vacuo. Uncertainties connected with dispersion in air are thus eliminated. The values are given to 8 significant figures and this accuracy is justified. For details of the optical apparatus see Abstr. 4466 (1933). L. S. G.

535.417 : 539.23 308

Measurement of thickness of thin films. GUNN, A. F., AND SCOTT, R. A. *Nature, Lond.*, **158**, 621 (*Nov.* 2, 1946).—Tolansky's technique [Abstr. 609, 2850 (1946)] was used to measure the "step" at the edge of films of collodion, silica and gold of thickness of 100 Å and above, supported on a smooth glass plate (e.g. lantern slide cover).

535.42 309

A note on singularities occurring at sharp edges in electromagnetic diffraction theory. BOUWKAMP, C. J. *Physica, 's Grav.*, **12**, 467–74 (*Oct.*, 1946).

535.421 = 82 310

A theorem in the theory of diffraction and its application to the diffraction by a narrow slit of arbitrary length. LEONTOVICH, M. *J. Exp. Theor. Phys.*, **16** (*No.* 6) 474–9 (1946) *In Russian.*—The problem of the diffraction of a plane wave by an aperture of arbitrary dimensions and shape in a thin plane screen of ideal conductivity, can be reduced to the problem of diffraction on an ideally reflecting plane of the same shape as the aperture. In the case of a slit of width small compared with the wavelength, the problem reduces to that of the excitation of a thin oscillator and may therefore be solved completely. A.

535.435 311

Investigations of the distribution of scattered light intensity near the Rayleigh line by means of a resonance filter. FYEDISH, A. *J. Phys., USSR*, **10** (*No.* 2) 191–5 (1946).—A resonance filter, consisting of Na vapour mixed with inactive gas, whose transmission properties were adjusted by variation of vapour pressure, was used to investigate the spectrum of scattered Na light from C_6H_6, CS_2, CCl_4 and $C_6H_5NO_2$ in the region close to the main line. The absorption processes are analysed, and an estimate made of the reliability of the results, which are presented in the form of graphs. The curves are not monotonic except in the case of nitrobenzene.

535.435 312

On the depolarization of scattered light in some hydrocarbons of paraffin series. FABELINSKY, I. *J. Phys., USSR*, **10** (*No.* 3) 231–5 (1946).—The depolarization of the Rayleigh scattering of light was measured for 25 liquid hydrocarbons. Experimental errors in the measurements of the depolarization coefficient of scattered light are discussed. The depolarization coefficient of scattered light is somewhat increased with increase of the length of the carbon chain. In the transition from normal hydrocarbons to their isomers the depolarization coefficient decreases markedly. From the measurements of liquid hydrocarbons, conclusions can be drawn as to the geometrical structure of the molecules. A.

535.511 313

Inhomogeneous light polarizing systems. OSTERBERG, H. *J. Opt. Soc. Amer.*, **36**, 469–77 (*Aug.*, 1946).—The effects of the birefringent elements are analysed theoretically, using plane Cartesian coordinates, and examined experimentally in selected cases. Interference between two coherent rays is controlled by the system. Polarized light is condensed on to a pinhole and the diffraction pattern observed with a microscope. The aperture of the microscope objective is broken into two zones, one circular, one annular, by two plates which may be both dichroic and birefringent, and thus phase differences between, and relative amplitudes of the zonal electric vectors may be varied. In front of the eyepiece is placed an analyser. Mathematical relationships are derived for the phases and amplitudes of the fast and slow vectors which emerge from the zones, in terms of the incident vector, the optical properties and azimuths of the plates. The general case of arbitrary orientations and the particular cases of orthogonal emergent vectors are considered. For a system producing orthogonal vectors in which the plate nearest the objective is a $\lambda/4$ plate with no dichroism extending across both zones, and the second plate consists of two orthogonal polaroids suitably orientated, the amplitudes of the two emergent fast vectors are shown to be equal and their phase difference variable from $-180°$ to $+180°$. With interference of the two vectors, the phase difference is varied by rotation of the polarizer and the relative amplitudes by rotation of the analyser, the latter not affecting the phase difference if its vibration direction lies between the directions of the emergent vectors. The polaroids may be replaced by two orthogonal $\lambda/4$ plates. These produce both slow and fast components of equal amplitudes which combine to form two linearly polarized orthogonal vectors if the azimuth of the incident light is $+135°$ or $+45°$ with respect to the principal axis of the first $\lambda/4$ plate. The phase difference between the resultant zonal vectors can be made equal to $\pm 90°$. By observing the Airy disc of the diffraction pattern with a petrographic microscope and using a wavelength of 5 461 Å the last two cases are experimentally verified. H. G. J.

535.543 : 549.211 : 548.232.2 *see Abstr.* 456

535.642 314

The complete, three-dimensional colour domain and its metrics. SILBERSTEIN, L. *Phil. Mag.*, **37**, 126–44 (*Feb.*, 1946).—The colour domain is labelled by 3 independent components, the so-called stimuli co-ordinates, x_1, x_2, x_3. The domain is initially amorphous, i.e. non-metrical, but it is metricized by impressing upon it the colorimetric tensor. The trichromatic normal law for the whole domain is derived on the assumption that the matching probability is an invariant with respect to the selection of the labelling system (x_1, x_2, x_3). This law is expressed thus: $F(x, y, z) = A \exp \{- C_{ij}x^i x^j\}$, where the covariant second rank tensor (C_{ij}) is impressed upon the domain to yield the metric $ds^2 = C_{ij}dx^i dx^j$. Various results concerning the matching of colours are deduced. L. S. G.

535.642 : 535.662.1 *see Abstr.* 316

535.642 : 612.843.31 *see Abstr.* 492

535.661.3 : 666.112.4 315

Colour of heavy lead silicate glasses. HAMPTON, W. H. *Nature, Lond.*, **158**, 582 (*Oct.* 26, 1946).—By using pure materials, melted in a pure thoria crucible, a glass of index 1·90 was produced which had no appreciable yellow colour. A Pt crucible contributed some colour, as did oxides of Fe, Cu and Cr in the ratio 1 : 2 : 40.

535.662.1 : 535.642 316

Trichromatic specification of interference colours. PRINS, J. A., AND REESINCK, J. J. M. *Physica, 's Grav.*, **12**, 396–401 (*Sept.*, 1946).

535.822.9 : 549.12 *see Abstr.* 476

HEAT 536

536.2.01 : 539.11 : 548.7 317

On the thermal equilibrium between spins and crystal lattice. AKHIESER, A., AND POMERANCHUK,

J. Phys., USSR, **8** (*No.* 4) 206–15 (1944).—A study of relaxation phenomena. The quantity of heat, Q, transferred in unit time from the lattice to the spins is shown to be of the form, $Q = T_s^5 f(T_s/T_l)$, where T_l and T_s are the equilibrium temperatures of the lattice and the spins respectively, and $f(x)$ is a certain function defined by a multiple integral. The latter is evaluated and simplified for $x \ll 1$ and $x \simeq 1$. The relaxation time is also calculated. This is the time required for the temperatures of the spins and of the lattices to become uniform. A numerical example is given. L. S. G.

536.21 : 536.483 318

On the heat conductivity of salts used in the magnetic cooling method. AKHIESER, A., AND POMERANCHUK, I. *J. Phys., USSR*, **8** (*No.* 4) 216–18 (1944).—A continuation of the previous paper [Abstr. 317 (1947)]. The heat conductivity is due to (1) the oscillations of the lattice and (2) the existence of the energy spectrum of the spin system. The contributions from each of these sources is calculated, and it is shown that in a certain temperature range only the contribution from the energy spectrum is of importance. This assumes no magnetic field. But if such a field is present in sufficient strength the contribution from (2) is negligible and it is necessary to consider the part arising from (1). L. S. G.

536.212.2 : 537.311.31 : 538.114 *see Abstr.* 382

536.413 : 548.73 : 549.211 319

Thermal expansion of diamond. KRISHNAN, R. S. *Proc. Indian Acad. Sci. A*, **24**, 33–44 (*July*, 1946).—The change in the lattice spacing of diamond has been measured from 28° to 605° by the X-ray method modified to enable accurate determination of the rather small expansion. At ordinary temperature the increase in the lattice constant is small but at higher temperature is very rapid. Mean values for the coefficient of volume expansion have been determined from the observed changes in lattice constant and vary from $4{\cdot}36\times10^{-6}$ to $11{\cdot}76\times10^{-6}$ as the temperature is increased. Values of the Grüneisen constant have been deduced and vary from 1·1 at low temperatures to 1·3 at 600° and fall slightly at higher temperatures. W. R. A.

536.413.2 : 548.736.1 *see Abstr.* 472

536.42 : 541.183.36 *see Abstr.* 445

536.423.1 : 533.15 320

The rate of evaporation of droplets. Evaporation and diffusion coefficients, and vapour pressures of dibutyl phthalate, and butyl stearate. BRADLEY, R. S., EVANS, M. G., AND WHYTLAW-GRAY, R. W. *Proc. Roy. Soc. A*, **186** (*No.* 1006) 368–90 (*Sept.* 24, 1946).—The rate for drops of about 0·5 mm radius was studied by means of a microbalance over a range of atmospheric pressures down to about 0·1 mm of Hg. The results agree very well with the theory of Fuchs [Abstr. 372 (1935)], which had not previously been tested experimentally, but there is a wide departure from Langmuir's evaporation formula. The vapour pressures of the two liquids were measured by Knudsen's method and the evaporation and diffusion coefficients were calculated. L. S. G.

536.423.1 : 541.182.2 : 532.694 *see Abstr.* 234

536.424.1 : 548.736.1 *see Abstr.* 473

536.462 : 535.231.2 *see Abstr.* 274

536.48 321

A direct observation of two kinds of motion in helium II. ANDRONIKASHVILLI, E. *J. Phys., USSR*, **10** (*No.* 3) 201–6 (1946).—The existence of two kinds of flows in He II (viscous and potential) is confirmed by experiments. These flows may be characterized by introducing the concept of two effective densities of He II: a "normal" density P_n and a "superfluid" one P_s. The temperature-dependence of the ratio P_n/P_s is investigated. A.

536.48 322

Coagulation of fog in the liquid helium II. SAVICH, P., AND SHALNIKOV, A. *J. Phys., USSR*, **10** (*No.* 3) 299 (1946).

536.48 : 536.75 *see Abstr.* 327

536.48 : 536.77 : 536.633.1 *see Abstr.* 324

536.483 : 536.21 *see Abstr.* 318

536.49 : 532.61 = 82 *see Abstr.* 233

536.532 : 621.9.014 323

Measurement of tool-tip temperature. *Engineering*, **162**, 435–6 (*Nov.* 8, 1946).—[Abstr. 577 B (1947)].

536.63 : 530.145 : 537.312.62 *see Abstr.* 345

536.633.1 : 536.77 : 536.48 324

Specific heat and enthalpy of helium at low temperatures. ZELMANOV, J. *J. Phys., USSR*, **8** (*No.* 3) 129–34 (1944).—Previous measurements of the Joule–Thompson effect [Zelmanov, *J. Phys., USSR*, **3** (*No.* 1) 42 (1940)] permit the calculation of the specific heat, C_p, as a function of temperature. The result is $C_p = 1{\cdot}242(1 - 37.87pT^{-1\cdot633})^{-0\cdot6262}$, and the enthalpy is obtained by integrating with respect to T. The equation is valid for the temperature range 8–20°K. Direct measurements of C_p were undertaken, and the apparatus and results of the experiments are described. A method was chosen in which $\int C_p dT$ was measured with respect to the heat of vaporization of He, along the isobar $p = 1$ atmos. The measured and calculated values of C_p are in good agreement. L. S. G.

536.655 325

The heat of vaporisation as a function of pressure and temperature. HAGGENMACHER, J. E. *J. Amer. Chem. Soc.*, **68**, 1633–4 (*Aug.*, 1946).—The heat of vaporization has been deduced as a function of pressure and temperature from an analytic expression of the line of saturation of liquids and vapours, and is expressed by the equation

$L = (RT^2/MP)(dp/dT)\{1 - DP/T^3\}^{\frac{1}{2}}$ (where $D = T_c^3/P_c$)

which is applicable for all liquids for which critical pressure, critical temperature and vapour pressure are known. W. R. A.

536.658 : 536.75 : 541.183.36 *see Abstr.* 446

536.662 : 621.385.032.216 : 537.533.9 *see Abstr.* 360

THERMODYNAMICS 536.7

536.71 326

Corresponding states in the frozen rare gases. MURPHY, G. W., AND RICE, O. K. *J. Chem. Phys.*, **14**, 518–25 (*Sept.*, 1946).—A method is presented for

extending the principle of corresponding states to solids at comparatively low temperatures, where quantum effects are appreciable. The method has been applied to solid Ne, A, Kr and Xe. The principle is used for calculation of the potential energies and interatomic distances of three of the substances in terms of the other. The quantum contribution to the energy is taken into account by assuming the Debye theory for all the solids, and this is related to the potential energy by means of a modified Grüneisen equation. The Debye Θ's for three of the solids are determined from that of the other by a dimensional analysis of the mechanical system. Using this information, C_p for Ne, A and Kr have been calculated from the experimental data for Xe. Agreement of the calculated values with experiment is reasonably good; small deviations may be caused by breakdown of the Debye theory, or may be indications of inexactitude in the law of corresponding states. A.

536.75 : 536.48 327

The entropy diagram for helium at low temperatures. ZELMANOV, J. *J. Phys., USSR*, **8** (*No.* 3) 135–41 (1944).—Results of a previous paper [Abstr. 324 (1947)] are used to calculate and make an entropy diagram in the temperature-pressure range, 3–20°K and 0·5–60 atmos. This is an improvement on the 1928 diagram of Keesom and Houthoff. For practical purposes the diagram with isobars, isochors and lines of constant enthalpy is convenient; this is the type constructed. The calculations are nowhere in error by >3%. L. S. G.

536.75 : 536.658 : 541.183.36 *see Abstr.* 446

536.77 : 536.48 : 536.633.1 *see Abstr.* 324

ELECTRICITY 537

537.122 : 538.3 : 530.145 *see Abstr.* 203

537.122 : 538.31 *see Abstr.* 395

537.122 : 538.632 : 537.311.1 *see Abstr.* 337

537.122 : 548.7 : 537.311.1 *see Abstr.* 338, 339

537.122 : 551.510.535 : 537.563 *see Abstr.* 365

537.123 : 539.152.1 *see Abstr.* 411

537.226 : 537.529 328

On the theory of dielectric breakdown in solids. FRÖHLICH, H. *Proc. Roy. Soc. A*, **188** (*No.* 1015) 521–32 (1947).—It is shown that the theory previously developed by the author [Abstr. 2160 (1941), 1682 (1942) is correct only below a critical temperature T_c. This temperature is defined in such a way that above T_c the density of electrons (in strong fields) is so high that mutual collisions between electrons are more frequent than collisions between electrons and the lattice vibrations. In the presence of strong external fields this leads to an equilibrium distribution of the electrons at an electronic temperature T which is higher than the lattice temperature T_0. T is determined by the energy balance according to which the rate of energy transfer from the field to the electrons must be equal to the rate of energy transfer from the electrons to the lattice vibrations. It is shown that equilibrium can be obtained only if the field is below a critical field F^*. For stronger fields the electronic temperature T rises steadily until the crystal breaks down. It is found that F^* decreases exponentially with increasing lattice temperature. The theory now accounts for the rise of dielectric strength with temperature at low temperatures (previous theory) and for its decrease at high temperatures. It also shows why influences which tend to increase the dielectric strength at low temperatures (e.g. admixture of foreign atoms) tend to decrease it in the high-temperature region. The increase of the electronic temperature with the field strength F leads (for $F < F^*$) to an increase of electronic conductivity with F which is calculated quantitatively. A.

537.226 : 539.32 : 537.228.1 *see Abstr.* 334

537.226 : 621.3.011.5 329

On the dielectric properties of ferro-electric (Seignette-electric) crystals and barium titanate. GINSBURG, V. *J. Phys., USSR*, **10** (*No.* 2) 107–15 (1946).—The properties of ferro-electric (Seignette-electric) crystals and of Ba titanate are discussed mainly in connection with the thermodynamical consideration of a phase transition from a non-pyro-electrical into a pyro-electrical crystal. A.

537.226.1 330

Dielectric constant of barium titanate at low temperatures. WUL, B. *J. Phys., USSR*, **10** (*No.* 1) 64–6 (1946).—The permittivity, κ, was measured at temperatures down to 2°K. At 4·2°K, $\kappa = 100$. The temperature coefficient for 2–4·2°K remains very large, 0·005–0·006 degree^{-1}. A.

537.226.1 : 537.228.2 *see Abstr.* 336

537.226.1 : 621.3.011.5 331

High dielectric constant materials. WUL, B. *J. Phys., USSR*, **10** (*No.* 2) 95–106 (1946).—The permittivities of the titanates of Group II of the periodic table have been investigated. It is shown that Ba titanate has a permittivity over 1 000 and is a new type of ferro-electric (Rochelle or Seignette-electric). A.

537.226.8 332

Dielectric dispersion in crystalline di-isopropyl ketone. SCHALLAMACH, A. *Nature, Lond.*, **158**, 619 (*Nov.* 2, 1946).

537.226.8 : 535.371 333

Electron traps and dielectric changes in phosphorescent solids. GARLICK, G. F. J., AND GIBSON, A. F. *Proc. Roy. Soc. A*, **188** (*No.* 1015) 485–509 (1947).—Some luminescent solids, such as ZnS with a specific impurity, exhibit considerable increases in their permittivity and loss when excited in the presence of a small electric field by ultra-violet light or other suitable radiation. The effect is confined to those phosphors which show photoconductivity associated with the luminescence process. The permittivity may increase by as much as 75% of the normal value (about 8) for quite moderate intensities of excitation. The loss, expressed as equivalent a.c. conductance, may change from less than 10^{-8} to 10^{-5} ohm^{-1} during excitation. Experimental investigations and theoretical considerations

show that the dielectric changes occur when electron traps are filled by electrons. The relatively low binding energy of the trapped electron to its trap (from 0·1 to 0·7 eV in most ZnS phosphors) permits large displacements of the electron from its mean position when an external field is applied. This gives rise to the increase in dielectric constant. Increase of loss is associated with the existence of a finite relaxation time of the filled electron traps. It is found from experiment that electrons moving in the conduction energy levels of the crystal make a comparatively negligible contribution to the dielectric effects, which are found to increase rapidly with temperature following an exponential variation. They are also dependent on the applied field frequency over the period range comparable in order to the relaxation time of filled electron traps ($\sim 10^{7}$ sec^{-1}). The relaxation time does not vary rapidly with the temperature. The dielectric changes show small variation with the wavelength of the exciting light between 0·35 and 0·41 μ, due to a rapid rise in the absorption coefficient of the phosphors. The long wavelength limit for production of the dielectric changes corresponds to the wavelength limit for photoconductivity and for the filling of electron traps, and is dependent upon the constitution and structure of the particular specimen. A.

537.228.1 : 537.226 : 539.32 334

Elastic, piezoelectric, and dielectric properties of sodium chlorate and sodium bromate. MASON, W. P. *Phys. Rev.*, **70**, 529–37 (*Oct.* 1 *and* 15, 1946).—The constants were measured over a wide temperature range. The value of the piezo-electric constant at room temperature is somewhat larger than that found by Pockels. The value of the Poisson's ratio was found to be positive and equal to 0·23 in contrast to Voigt's measured value of −0·51. At high temperatures the dielectric and piezo-electric constants increase and indicate the presence of a transformation point which occurs at a temperature slightly larger than the melting point. A large dipole piezo-electric constant (ratio of lattice distortion to dipole polarization) results for these crystals, but the electromechanical coupling factor is small because the dipole polarization is small compared to the electronic and ionic polarization and little of the applied electrical energy goes into orienting the dipoles. A.

537.228.1 : 621.396.611.21 = 82 335

Piezo-electric radiators and receivers. GUTIN, L. J. *J. Tech. Phys., USSR*, **16** (*No.* 1) 39–54 (1946) *In Russian.*—[Abstr. 506 B (1947)].

537.228.2 : 537.226.1 336

On the dielectric behaviour and electrostriction of solutions of electrolytes. DAVTJAN, O. *J. Phys., USSR*, **10** (*No.* 2) 183–90 (1946).—The relation between the permittivity and the electrostriction of solutions of electrolytes is theoretically investigated. The variation of the permittivity is proportional to the electrostriction. The electrostatic saturation depends upon the square of the effective electric field of the ions and also upon the external field. The permittivity of dilute solutions appears to be proportional to the concentration. A.

ELECTRIC CURRENTS 537.3

537.311.1 : 537.122 : 538.632 337

On a free electron gas in static magnetic and electric fields. LINDHARD, J. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 1) *Paper* 4, 17 *pp.* (1946).—A formula for the magnetic susceptibility of a free electron gas was obtained by Landau. General conditions for its application have now been deduced by the improved method developed by Klein [Abstr. 338 (1947)], which allows for the induced field of the electrons. The same method is used to find the effect of a perturbing electric field, and two limiting forms of the equations are then discussed. The Thomas–Fermi equation is obtained for the electric potential in a completely degenerate gas, and the Debye–Hückel equation is shown to apply to a gas obeying classical statistics. As a further application of the general equations, a value of the Hall effect is obtained, agreeing with previous results for a degenerate gas. G. J. K.

537.311.1 : 537.122 : 548.7 338

On the magnetic behaviour of electrons in crystals. KLEIN, O. *Ark. Mat. Astr. Fys.*, **31 A** (*No.* 2) *Paper* 12, 15 *pp.* (1945).—A study is made of the influence of a magnetic field on crystal electrons. In the case of a weak field, an integro-differential equation is obtained for the vector potential. Some properties of this equation are studied in the case of electronic wave functions of an ideal crystalline medium, neglecting spin. The case of free electrons in a weak field is discussed in detail, and this is a guide to the behaviour of lattice electrons in more general cases. L. S. G.

537.311.1 : 537.122 : 548.7 339

Energy distribution and stability of electrons in electric fields. FRÖHLICH, H. *Proc. Roy. Soc. A*, **188** (*No.* 1015) 532–41 (1947).—The behaviour of free electrons in ionic crystals in the presence of an external field is studied. It is shown that the usual method of calculating the electric current is incorrect. The correct solution shows that—on the usual assumption that electrons are scattered by the lattice vibrations only—a stationary state is impossible. Stationary conditions can probably be obtained by considering collisions between electrons as well. For very small electron density, however, these latter collisions are negligible. It is shown that in this case the possibility of reaching stationary conditions depends on the behaviour of electrons whose energy is large enough to ionize or excite ions of the lattice. A.

537.311.31 : 536.212.2 : 538.114 *see Abstr.* 382

537.311.31–972 : 621.317.332 340

Anomalous high-frequency resistance of ferromagnetic metals. GRIFFITHS, J. H. E. *Nature, Lond.*, **158**, 670–1 (*Nov.* 9, 1946).—The h.f. loss of a conductor is dependent on $\mu\rho$, where ρ is the electrical resistivity and μ the magnetic permeability. Normally, when a magnetic field > a few gauss is applied the differential permeability decreases steadily to 1. At wavelengths of 1–3 cm, however, there is a large increase of $\mu\rho$, having the appearance of a resonance at a certain magnetic field, which depends on the frequency. The method of making the measurements is described, and a tentative explanation advanced.

537.311.33 : 538.632 *see Abstr.* 400

537.311.33 : 548.736 341

Cerium tungstate as a semi-conductor. NELSON, J. B., AND MCKEE, J. H. *Nature, Lond.*, **158**, 753–4 (*Nov.* 23, 1946).—Homogeneous crystals with the formula $2CeO_2 . 3WO_3$ were prepared, from which the crystal structure has been elucidated by X-ray diffraction; the space group is probably $C_{2h}^6 - A_2/a$. The electrical conductivity characteristics above 1 000°c are given by $\sigma = A \exp(-B/kT)$ where $B = 14{\cdot}6$ eV. Other physical properties are given.

537.311.33 : 621.315.59 : 537.311.4 *see Abstr.* 342

537.311.4 : 537.311.33 : 621.315.59 342

Electrical resistance of the contact between a semi-conductor and a metal. JOFFE, A. V. *J. Phys., USSR*, **10** (*No.* 1) 49–60 (1946).—The contact potentials of a number of metals and semi-conductors were measured by means of the ionization method. There was no dependence of the contact potential on the temperature and on the specific conductivity of the specimen. The sign of the conductivity was determined by the sign of the thermo-electric force. The dependence of the resistances near the electrodes on the potential difference, temperature and on the current direction was studied. Rectification phenomena were feebly manifested. It was found that the relative value of the resistance near the electrodes is lower, the higher the specific resistance of the semi-conductor. A.

537.312.5 : 549.211 343

Local variations in the photoconductivity of diamond. ACHYUTHAN, K. *Proc. Indian Acad. Sci. A*, **24**, 162–7 (*July*, 1946).—Three cleavage plates which showed variations of u.v. transparency over their area were found to show greater photo-conductivity in their transparent than in their opaque regions, and the value of the photo-current in a region depends on the degree of transparency. Another plate, completely transparent to 2 250 Å and to 8 μ light, showed variations of photo-conductivity, probably on account of a variation in the degree of mosaicity of the crystal structure in different parts of the plate and, consequently, differences in the number of active centres from which electrons could be released by the incident radiation. W. R. A.

537.312.62 : 538.639 : 530.145 344

Some remarks on the quantum theory of the superconductive state. KLEIN, O., AND LINDHARD, J. *Rev. Mod. Phys.*, **17**, 305–9 (*April–July*, 1945).—Similar but more precise results than those given in a previous paper [Abstr. 338 (1947)] are now obtained. The integro-differential equation for the magnetic vector potential is solved and used to calculate the magnetic properties of the system in question. L. S. G.

537.312.62 : 536.63 : 530.145 345

On the specific heat of the superconductive state. KLEIN, O. *Ark. Mat. Astr. Fys.*, **33 B** (*No.* 1) *Paper* 2, 7 *pp.* (1946).—A continuation of earlier work [Abstr. 338, 344 (1947)]. A formula for the specific heat, C, is deduced, and this is used to develop a possible explanation of its characteristic features, the lack of the ordinary specific heat, the relatively large value of the third power Debye term and its sudden decrease, and the appearance of the first power term at the transition temperature. L. S. G.

537.32 346

Thermo-electric properties of conductors. I and II. GUREVICH, L. *J. Phys., USSR*, **9**, 477 (1945); **10** (*No.* 1) 67–80 (1946).

537.324 : 621.317.794 347

Rapid response thermopiles. HARRIS, L. *J. Opt. Soc. Amer.*, **36**, 597–603 (*Oct.*, 1946).—A technique has been developed for the evaporation of Bi and of Sb upon thin cellulose nitrate so that the metals have comparatively low electrical resistivities and comparatively high thermal e.m.f.'s. A procedure has been developed for making Bi–Sb radiation thermopiles in which units of 50 thermal junctions have a receiving area of $\sim 0{\cdot}11$ cm^2 and a resistance of $\sim$70 ohms. These units are called "folded thermopiles." The response of several folded thermopiles of different design operated at atmospheric pressure has been studied over a range of frequencies. The "folded" thermopiles are faster than any thermopiles reported heretofore, yet the response is greater for all frequencies above 5 c/s than for evaporated thermocouples operated in a vacuum. The thermopiles are robust, relatively free of microphonics and show very little noise in addition to "Johnson noise." A.

ELECTRIC DISCHARGES AND RADIATIONS
537.5

537.523.4 = 82 348

The mechanism of the progress of a discharge. ZINGERMAN, A., AND NIKOLAEVKAIA, N. *J. Exp. Theor. Phys.*, **16** (*No.* 6) 499–502 (1946) *In Russian.*—Photographs of incomplete breakdowns are given, made in investigating the mechanism of the discharge in long gaps. They show that the discharge channel is not formed by the progress of one avalanche from cathode to anode, but consists of separate stretches which grow together into one common channel. A.

537.523.4 349

Observation of spectral lines with electron multiplier tubes. CRAGGS, J. D., AND HOPWOOD, W. *Nature, Lond.*, **158**, 618 (*Nov.* 2, 1946).—Using sealed-off triggered spark gaps in which breakdown voltage and current are accurately repeated, considerable fluctuations are still observed in the electrode vapour spectral lines emitted by spark discharges [see also Abstr. 206 (1944), 2895 (1946)].

537.523.5 350

The hypothesis of minimum voltage in the theory of the arc. ELENBAAS, W. *Physica, 's Grav.*, **12**, 491–8 (*Oct.*, 1946).—The author does not agree with the explanation of the contraction of the high-pressure discharge in the vicinity of the cathode, as given by Weizel and Rompe [Abstr. 1124 (1944)], making use of the hypothesis of minimum voltage. It is shown, with the aid of Seeliger's considerations [Abstr. 1088 (1942)] regarding arcs in which the loss of energy is mainly due to thermal conduction, that the diameter, as given by the hypothesis of minimum voltage, is far too small at normal current intensities. This discrepancy being a function of temperature, it is con-

sidered that the relative behaviour of the arc characteristics is not rightly described by the theory of minimum voltage. At very high current densities, at which ionization is almost complete, the principle of minimum voltage gives good results. A.

537.525 = 82 351

Evolution of heat at the anode of a gas discharge. NERETINA, N. A. *J. Tech. Phys., USSR*, **16** (*No.* 3) 353–6 (1946) *In Russian.*—The accuracy of methods for calculating the heat evolution at the anode, from the mean kinetic energy of electrons reaching it, was investigated with a specially developed Hg vapour discharge tube. Measurements were taken at pressures of 0·001 and 0·01 mm/Hg, and discharge current 1 A, voltage 120 V. Anode temperatures were between 200 and 550°C. The power evolved at the anode, as obtained from calorimetric measurements, showed good agreement with values obtained from the equation for positive anode drop: $P = i(2kT_e/e + \phi_a + U_a)$. ($P$ = power; $2kT_e/e$ = mean kinetic energy of the electrons; ϕ = energy of egress; U_a = anode drop.) For negative values of U_a, the powers correspond to the equation: $P = i(2kT_e/e + \phi_a)$. R. M.

537.525.72 : 535.33.03 352

Electrodeless discharges at high frequencies and low pressures. NISEWANGER, C. R., HOLMES, J. R., AND WEISSLER, G. L. *J. Opt. Soc. Amer.*, **36**, 581–7 (*Oct.*, 1946).—Information on the characteristics of such discharges at frequencies of 10, 15, 20 and 25 Mc/s and pressures from 10^{-2} to 10^{-4} mm of Hg, using dry air as the filling gas, is presented in the form of onset and offset potentials *v.* pressure as an aid in the design of spectroscopic light sources and associated electrical equipment. A.

537.525.92 353

On the vibrations of the electronic plasma. LANDAU, L. *J. Phys., USSR*, **10** (*No.* 1) 25–34 (1946).—The vibrations of the electronic plasma are considered, which arise as a result of an arbitrary initial non-equilibrium distribution in it. The vibrations are always damped, and the dependence of the frequency and of the decrement on the wave vector is determined for small and for large values of the latter. The penetration of a periodical external electric field into the plasma is considered. The case of the frequency of the external field being almost at resonance with the natural frequency of the plasma is considered separately. A.

537.529 : 537.226 *see Abstr.* 328

537.531 : 535.3 : 548.73 354

The effect of temperature on the intensity of X-ray reflexion. OWEN, E. A., AND WILLIAMS, R. W. *Proc. Roy. Soc. A*, **188** (*No.* 1015) 509–21 (1947).—The effect has been studied by making microphotometric measurements on lines in X-ray structure spectra obtained with powder specimens of Au, Cu and Al in a Debye–Scherrer camera. A special method was employed to make cylindrical specimens, 0·8 mm in diameter, without adhesive and free from a core of foreign material. The primary beam was standardized by means of a flat-plate X-ray camera, furnished with a plate of powdered gold which provided a spectrum whose lines could be accurately measured. The powder specimen was maintained *in vacuo* at temperatures up to about 900°K, estimated from lattice parameter measurements. The observed fall in intensity of X-ray reflection by Au and Cu as the temperature is raised up to about 900°K can be accounted for if the characteristic temperature Θ varies in accordance with the relation $\Theta_T = \Theta_1[1 - \alpha\gamma(T - T_1)]$, where Θ_T and Θ_1 are the values at temperatures T and T_1, α is the cubical coefficient of thermal expansion and γ is the Grüneisen constant. This relation is found to hold also for Al up to about 600°K, beyond which the intensity falls more rapidly, and it is suggested that another factor becomes prominent in the case of Al at the higher temperatures. The values of Θ agree with the values obtained at corresponding temperatures by specific heat and electrical conductivity methods. A.

537.533.72 : 551.594.221 355

The image of objects produced by lightning and impulse discharge in the atmosphere. SPIWAK, G., AND KARDASH, J. *J. Phys., USSR*, **10** (*No.* 3) 252–6 (1946).—Lightning sometimes imprints images of surrounding objects on the bodies of people struck by lightning. By means of impulse discharges at atmospheric pressure, images of metallic objects placed at various distances from the photographic film were obtained artificially. Impulse corona, Lichtenberg figures, surface spark discharge and other transient forms of discharge are superimposed on these images (depending upon the experimental conditions). These types of discharge distort the image. At some distance of the object from the film the laws of electron optics apply. At atmospheric pressure, a discharge, originating from individual points of the object, is restricted to a narrow channel. The channel itself is often formed in the direction of the lines of electric force and fills up with positive charge on account of gas ionization and removal of electrons. This space charge yields a radial field which focuses the electrons ("electrical" lens). At heavy lightning currents the resultant self-magnetic field may constrict the discharge and prevent the electrons from spreading out ("magnetic" lens). A.

537.533.74 356

Scattering of relativistic electrons through large angle. ALICHANIAN, A., ALICHANOW, A., AND WEISSENBERG, A. *J. Phys., USSR*, **9**, 280 (1945).—The elastic scattering through 90° by thin foils of celluloid, Al, Cu, Ag and Au was investigated for electrons of energy 600–2 000 keV, using Geiger–Müller counters. Wentzel's criterion of single scattering was shown to be unsatisfactory, and the thickness of layers giving single scattering was found. The variation of cross-section with energy follows Mott's formula, and the absolute values agree with those calculated from it, except for Au, which is 2½ times too low. A.

537.533.74 357

Single scattering of fast β-particles by protons. RAY, R. R., AND CHAMPION, F. C. *Nature, Lond.*, **158**, 753 (*Nov.* 23, 1946).—Two cases of elastic scattering through angles >20° were found in 800 photographs of cloud chamber tracks, corresponding to about 124 m of track. No inelastic collisions were found. Within the limits of the large statistical fluctuation, this is in agreement with Mott's theory.

537.533.74 : 530.145 358

Reaction of radiation on electron scattering and Heitler's theory of radiation damping. BETHE, H. A., AND OPPENHEIMER, J. R. *Phys. Rev.*, **70**, 451–8 (*Oct.* 1 *and* 15, 1946).—The reaction of radiation on the scattering of electrons is treated on the basis of Heitler's theory of radiation damping. Because in this theory no account is taken of virtual processes, the infra-red catastrophe reappears, and the theory gives a total cross-section for scattering, which depends critically on the longest wavelength radiation that can be emitted, and which does not agree with the correspondence principle. It seems probable that only by a modification of present theories specific to the domain of high energies and small distances will a satisfactory solution of this simple problem be found.

537.533.74 : 538.3 : 530.145 *see Abstr.* 204

537.533.9 : 538.3 359

The radiation of fast electrons in a magnetic field. ARZIMOVICH, L., AND POMERANCHUK, I. *J. Phys., USSR*, **9**, 267 (1945).—The spectra and angular distribution is studied. It is shown that practically all the energy of the radiation is concentrated in the orbital plane. The frequency spectrum consists of series of equidistant lines whose centre has a wavelength about equal to the radius of the orbit divided by $(W/m_0c^2)^3$, where W is the energy of the electron. It is shown that for non-interacting electrons the intensities of radiation do not interfere. The criterion of "the smallness" of the interaction of the electrons is derived. The influence of the radiation damping on the orbit of the electron is studied, and a formula is derived for the magnitude of contraction of the orbit by the action of this force. The question of the maximum energy obtained in betatrons is discussed on the basis of theoretical calculations. A.

537.533.9 : 536.662 : 621.385.032.216 360

Dissociation energies of surface films of various oxides as determined by emission measurements of oxide coated cathodes. JACOBS, H. *J. Appl. Phys.*, **17**, 596–603 (*July*, 1946).—A mechanism of falling emission in vacuum tubes is discussed. It is shown that when an electron achieves a critical kinetic energy in moving from the cathode to the anode, and if the anode is an oxide, the electrons will cause a dissociation of the oxide. The liberated O_2 will return to the cathode and falling emission will result. The critical energy of the electron starting the dissociation is found to be equivalent to the heats of formation of the oxides bombarded in the case of 5 different oxides. Using this equivalence principle, the heats of formation of Ta_2O_4 and ZrO are found. In addition, the contact potential between BaO cathodes and 7 other oxides are determined and the work function of the 7 oxides computed. A.

537.534.74 361

On the elastic scattering of fast charged particles by nuclei. AKHIESER, A., AND POMERANCHUK, I. *J. Phys., USSR*, **9**, 471 (1945).—The scattering of fast particles which can be absorbed by nuclei is considered. The picture of scattering is equivalent to the diffraction of charged waves by an absolutely black sphere. The formulae obtained are a generalization of the diffraction scattering of fast neutrons for the case of charged particles. A.

537.542 362

The Geiger–Müller counter with a hollow anode. MIKHALEVA, T. *J. Phys., USSR*, **10** (*No.* 3) 296 (1946).

537.542 : 519.21 : 539.16.08 = 82 *see Abstr.* 415

537.542 : 621.385.18 363

Magnetically-controlled gas discharge tubes. MAKINSON, R. E. B., SOMERVILLE, J. M., MAKINSON, K. R., AND THONEMANN, P. *J. Appl. Phys.*, **17**, 567–72 (*July*, 1946).—[Abstr. 466 B (1947)].

537.56 : 551.594.12 364

Influence of water drops on the ionization and electrification of air. FRENKEL, J. *J. Phys., USSR*, **10** (*No.* 2) 151–8 (1946).—The influence of a water drop suspended in an ionized atmosphere on the rate of discharge of the ions is considered, and the electrical charge acquired by the drop in a steady state, due to a difference of ionic mobilities and concentrations (at large distances) is calculated. This charge is compared with that acquired as a result of the adsorption and de-adsorption of the ions with preservation of their charges and, in the general case, of a combination of neutralization and de-adsorption. The actual value of the potential and charge of water drops (cloud particles) in air due to its ionization is considered, and the influence of the concentration of such drops (or any other small particles) on the ionization and electrification of the surrounding air is determined. A.

537.563 : 537.122 : 551.510.535 365

On the mean energy of electrons released in the ionization of gas. DRUKAREV, G. *J. Phys., USSR*, **10** (*No.* 1) 81–4 (1946).—Because an electron released by ionization gives up its energy during a large number of collisions, the mean energy of the electron is, under certain conditions, larger than the thermal energy of the remaining gas. The conditions under which the notion of temperature can be applied to the electron gas are considered. A formula for the electron temperature is derived. The results obtained are applied to the calculation of the electron temperature in the ionosphere. A.

537.564 : 551.510.535 366

The mechanism of ionospheric ionization. WOOLLEY, R. v. D. R. *Proc. Roy. Soc. A*, **187**, 102–14 (*Oct.* 8, 1946).—Various mechanisms for the production of electrons in the E, F_1 and F_2 regions are discussed. It is concluded that the observed electron densities may be accounted for without requiring far higher solar u.v. radiation than would be emitted by a black body at 6 000°. The effective recombination coefficient in the F_2 region must be about 10^{-11}. The conditions under which 2 observable regions could be formed by the ionization of O and N_2 are examined; and also the contributions of metastable states of atoms and molecules to electron densities. The F_2 and E regions are attributed to the ionization of atomic and molecular oxygen respectively. The electrons forming the F_1 region are assumed to be due to metastable N_2 or NO. L. S. G.

537.565 367

The motion of positive ions in the electric field in a gas. SENA, L. *J. Phys., USSR*, **10** (*No.* 2) 179–82 (1946).—In considering the charge exchange to be the basic process of interaction between ion and atom, a proportionality is shown to exist in strong fields

between mean velocity of drift of ions in the direction of the field and the square root of the ratio E/p. In the first approximation the relation obtained may be extended also to such comparatively weak fields as the plasma fields. The results obtained are in fair agreement with the experimental data available. The distribution of the velocities of ions is of a sharply pronounced anisotropic nature and cannot be associated with the concept of temperature. A.

537.582 = 82 368

Some cases of interaction of positive ions and metallic surfaces. MORGULIS, N. *J. Exp. Theor. Phys.*, **16** (*No.* 6) 489–94 (1946) *In Russian.*—The possibility of determining the contact potential differences of thoriated tungsten by means of the method of ion-current characteristics shift, obtained by thermal ionization, has been experimentally investigated. The inapplicability of this method has been established and the reasons for it made clear. Two cases of contact phenomena on metallic surfaces on which positive ions accumulate steadily, with hindered neutralization of the ions, are considered; conditions leading to equilibrium in this case are determined. A.

COSMIC RAYS 537.591

537.591.1 369

Intensity of the corpuscular and the photon component of cosmic radiation at sea level. CLAY, J., AND LEVERT, C. *Physica, 's Grav.*, **9**, 158–68 (*Feb.*, 1942).—From comparison of single counts and 2- and 3-fold coincidences, the number of photons and the efficiency of counters for photons was found. The latter lay between 3 and 6%. The numbers found for the photons and corpuscular rays arriving per minute are given in terms of the zenith angle and compared with those of other authors. The ratio of photons to corpuscles increases from 10 at 0° to 30 at 90°. A.

537.591.1 370

Photonic and non-ionizing cosmic radiation. CLAY, J., AND LEVERT, C. *Physica, 's Grav.*, **12**, 321–50 (*Sept.*, 1946).—Previous investigations [Abstr. 369 (1947)] were extended to energies $>10^7$ eV, using a more complex counter system arranged to record simultaneously the ionizing particles and those non-ionizing ones which produced at least one electron in a layer of Pb (principle of anti-coincidences). It was possible to distinguish between photons giving Compton electrons, and photons producing pairs of electrons, the ratio being 28 : 1, and the absorption coefficients 0·29 and 1·05/cm Pb respectively (1·175/cm Fe for the latter also). The ratio of photons to ionizing particles was 1, but not all the latter were electrons; the ratio of photon-produced pairs of electrons to electron-produced pairs was 7 : 3. No trace could be found of meson scattering, neutral mesons, or of neutrons. A.

537.591.1 371

On the space correlation of particles in cosmic rays. I. Correlation between electrons and photons. BERETZKY, V. *J. Phys., USSR*, **10** (*No.* 3) 211–16 (1946).—A calculation of the number of double coincidences between electrons and photons caused by the bremsstrahlung and the Compton effect is given. A.

537.591.15 372

Ionization bursts created by mesotrons. BELENKY, S. *J. Phys., USSR*, **10** (*No.* 2) 144–50 (1946).—Bursts created by electrons "knocked-on" by mesotrons are considered. The spectrum of mesotrons is taken into account. The expression obtained for the number of bursts differs considerably from that given by other authors. A.

537.591.15 373

Penetrating cosmic ray showers at 3 860 m above sea level. BELL, L., BIRGER, N., AND VEKSLER, V. *J. Phys., USSR*, **10** (*No.* 2) 198–9 (1946).

537.591.15 374

On narrow showers. ALICHANIAN, A., AND ALEXANDRIAN, A. *J. Phys., USSR*, **10** (*No.* 3) 296–7 (1946).

537.591.15 375

Recurrence phenomena in small cosmic-ray bursts. BROXON, J. W. *Phys. Rev.*, **70**, 494–8 (*Oct.* 1 *and* 15, 1946).—Chree's method of superposed epochs was employed in the statistical investigation of variations in the frequency of occurrence of small cosmic-ray bursts which produced 2·9 to 3·6 million pairs of ions in a shielded spherical ionization chamber of 13·3 l effective volume containing air at 160 atmos. The analysis was carried out only for the range of day numbers from −45 to +45. Irregular secondary pulses were found both preceding and subsequent to both positive and negative primary pulses. Both subsequent and preceding difference curves and the combination difference curve displayed secondary pulses with peaks at about 27 days preceding and subsequent to the primary pulses. The secondary pulses amounted to about 3 or 4% of the average frequency of approximately 37 small bursts per day, and about 10% of the larger variations constituting the primary pulses. A.

537.591.3 376

Measurements of the absorption of cosmic rays at an altitude of 3 050 m above sea level. ALICHANIAN, A., AND WEISSENBERG, A. *J. Phys., USSR*, **10** (*No.* 3) 293–4 (1946).

537.591.3 377

An investigation of the absorption of cosmic rays in a strong magnetic field at 3 250 m above sea level. ALICHANIAN, A., ALICHANOW, A., NIKITIN, S., AND WEISSENBERG, A. *J. Phys., USSR*, **10** (*No.* 3) 294–5 (1946).

537.591.5 : 525.235 378

Changes in cosmic ray intensity associated with magnetic storms. ALFVÉN, H. *Nature, Lond.*, **158**, 618–19 (*Nov.* 2, 1946).—Since the changes are observed both at regions of high and of low geomagnetic latitude, they cannot be attributed to variations of the magnetic field either of the earth or of the sun. The suggestion is made that the variations are due to changes in the earth's electrostatic potential as it passes through an ionized cloud emitted by the sun, and polarized by the sun's magnetic field. An approximate calculation indicates

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that the difference of potential between the two sides of the cloud might be in excess of 50 MV, and the earth would pass from a negative potential at the beginning of the storm to a positive at the end, resulting in an increase of cosmic radiation followed by a decrease.

537.591.8 379

Ionizing power of particles of the hard and soft components of the cosmic radiation. DOBROTIN, N. *J. Phys., USSR*, **10** (*No.* 3) 207–10 (1946).

MAGNETISM 538

538.082.74 : 621.317.44 380

A note on the mercury jet magnetometer. RHODERICK, E. H. *Rev. Sci. Instrum.*, **17**, 453 (*Oct.*, 1946).—[See Abstr. 3055 A (1945)].

538.114 381

Theory of the relaxation processes in ferromagnetics at low temperatures. AKHIESER, A. *J. Phys., USSR*, **10** (*No.* 3) 217–30 (1946).—The time for attaining equilibrium in Bloch's system of spin waves, which describes the state of ferromagnetics near saturation, is determined. This time is given by

$$\tau_s \simeq \frac{\hbar I}{4\sqrt{\pi W^2}}\left(\frac{\Theta_c}{T}\right)^{\frac{1}{2}}\left(\log_e \frac{kT}{W}\right)^{-2}$$

where W is the magnetic interaction energy of the neighbouring ions, I is the value of the exchange integral, T is the temperature of the body, Θ_c is the Curie temperature. For $T = 10°\text{K}$, $\tau_s \simeq 10^{-7}$ sec. Apart from the interaction between the spin waves, there exists also the interaction between spin waves and vibrations of the lattice. At $T > 0{\cdot}5°\text{K}$ the main part of this interaction is due to the scattering of spin waves by the lattice vibrations, with a simultaneous absorption or emission of a phonon. If $T < \Theta^2/\Theta_c$ (Θ = the Debye temperature) the rate of attaining equilibrium in the system of spin waves is greater than that between the spin waves and the lattice. In this case the concept of the spin waves temperature, which can be different from the temperature of the lattice, has significance. The time of levelling of the temperatures is of the order

$$\tau \simeq \pi \frac{M a^2}{\hbar}\left(\frac{\Theta_c}{\Theta}\right)^3 \frac{\Theta_c}{T} \exp\left(\frac{1}{4}\frac{\Theta^2}{T\Theta_c}\right)$$

(M = the mass of the atom, a = the lattice constant.)

A.

538.114 : 537.311.31 : 536.212.2 382

On the theory of ferromagnetism. GEYLIKMAN, B. T. *J. Phys., USSR*, **8** (*No.* 3) 182–91 (1944).—The results of a previous paper [Abstr. 2370 (1945)] are extended and used to calculate the variation with temperature of the magnetic moment of ferromagnetics at low and high temperatures. In the latter case the variation differs only slightly from that given by Heisenberg's formula [Abstr. 2835 (1928)]. The theory of the conductivity of ferromagnetics is developed and expressions are obtained for the electrical and thermal conductivities. These agree with experimental results. L. S. G.

538.114 : 548.0 383

Transverse magnetization in ferromagnetic crystals in relation to domain structure. VON ENGEL, A., AND WILLS, M. S. *Proc. Roy. Soc. A*, **188** (*No.* 1015) 464–84 (1947).—In the formal theory of ferromagnetic anisotropy the magnetic energy of a crystal is expressed in terms of the magnetic field strength, and the angles between the easy directions of magnetization and the field and magnetization vectors respectively. Although the magnetization curves of single crystals are in good agreement with this theory as regards the components of magnetization parallel to the field, this is not true of the transverse component. A simple treatment is developed which covers the whole range of field strength. The directions of magnetization of domains are treated as distributed continuously in angle, rather than as restricted to a limited number of particular directions. By assuming that the proportion of the volume of domains magnetized in any direction is larger the lower the energy of magnetization in that direction, reasonable agreement with the experimental results is obtained. Although the distribution assumed is of the Boltzmann type, the energy of distribution is not of thermal origin and its value is very much greater than kT. It is likely that the distribution is due to internal stresses or lattice imperfections. The observations by Honda and Kaya [Abstr. 1888 (1927)] have been newly corrected for demagnetization as regards magnitude and angle. A.

538.213 : 621.318.042.15 384

Permeability of dust cores. LAMSON, H. W. *Wireless Engr*, **23**, 313–15 (*Nov.*, 1946).—[Abstr. 401 B (1947)].

538.221 385

Magnetic dispersion of iron oxides at centimetre wavelengths. BIRKS, J. B. *Nature, Lond.*, **158**, 671–2 (*Nov.* 9, 1946).

538.221 : 621.318.22 = 4 386

Preparation and magnetic properties of the compound Fe_4N. GUILLAUD, C., AND CREVAUX, H. *C.R. Acad. Sci., Paris*, **222**, 1170–2 (*May*, 1946) *In French.*—[Abstr. 403 B (1947)].

538.222 387

Measurements on paramagnetic relaxation in chromium potassium alum. CASIMIR, H. B. G., BIJL, D., AND DU PRÉ, F. K. *Commun. K. Onnes Lab., Leiden* (*No.* 262*a*). *Physica, 's Grav.*, **8**, 449–60 (*May*, 1941).—Earlier measurements [Abstr. 3809 (1939)] were continued. Experimental data obtained at liquid He temperatures on the real and imaginary part of the differential susceptibility are given for chromium potassium alum. A.

538.222 388

Paramagnetic relaxation in copper potassium sulphate. BIJL, D. *Commun. K. Onnes Lab. Leiden* (*No.* 262*b*). *Physica, 's Grav.*, **8**, 461–8 (*May*, 1941).

538.222 389

Paramagnetic relaxation in a diluted chromium potassium alum. BIJL, D. *Commun. K. Onnes Lab. Leiden* (*No.* 262*c*). *Physica, 's Grav.*, **8**, 497–507 (*May*, 1941).—Measurements were carried out on a mixed crystal of chromium potassium alum and aluminium potassium alum in the liquid He range. A.

538.222 390

Paramagnetic absorption in some salts in perpendicular magnetic fields. ZAVOISKY, E. *J. Phys., USSR*, **10** (*No.* 2) 170–3 (1946).—Measurements of the relative value of paramagnetic absorption in perpendicular magnetic fields for frequency of $1{\cdot}51\times10^5$ kc/s are performed for the following salts: $CuCl_2 . 2H_2O$; $CuSO_4 . 5H_2O$; $CrCl_3$ and $MnCO_3$. A.

538.222 391

Time effects in the magnetic cooling method. II. TEMPERLEY, H. N. V. *Proc. Camb. Phil. Soc.*, **43**, 118–21 (*Jan.*, 1947).—Data on relaxation effects [Abstr. 389 (1947)] are discussed in the light of a paper by Temperley [Abstr. 2143 (1939)], and excellent agreement is found with the conclusions of that paper. The primary effect of diluting the salt is to reduce the magnetic interaction, and the observed effects are a big increase in the relaxation time in zero field, and a decrease of the relaxation time with increasing field instead of an increase. It is predicted that a decrease should set in with an ordinary salt at liquid helium temperatures at fields somewhat higher than have so far been used. Van Vleck's criticisms [Abstr. 1661 (1940)] of Temperley's paper are discussed, and it is concluded that they are not valid in their present form. A.

538.23/.24 392

On the connection between the magnetization and hysteresis curves of polycrystalline ferromagnetic bodies. POPZOV, N., AND TCHERNIKOVA, L. *J. Phys., USSR*, **10** (*No.* 1) 85–91 (1946).—The substances studied, permalloy, alsifer, Co, Fe, and annealed steel, possessed low constants of magnetic anisotropy. The connection between magnetization and hysteresis curves deduced theoretically by Kondorsky [Abstr. 1135 (1943)] was confirmed. A.

538.247 393

Demagnetization experiments on diluted chromium alum. DE KLERK, D., AND POLDER, D. *Commun. K. Onnes. Lab. Leiden* (*No.* 262*a*). *Physica, 's Grav.*, **8**, 508–12 (*May*, 1941).

538.248 394

On temperature dependence of the coercive force in single crystals of transformer steel. SHUR, J. *J. Phys., USSR*, **10** (*No.* 3) 299 (1946).

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3 : 537.122 : 530.145 *see Abstr.* 203

538.3 : 537.533.74 : 530.145 *see Abstr.* 204

538.3 : 537.533.9 *see Abstr.* 359

538.31 : 537.122 395

On the back action of the electromagnetic field on a moving electron. MARKOV, M. *J. Phys., USSR*, **10** (*No.* 2) 159–66 (1946).—The equation of motion of an electron is considered in the form of an integral equation with respect to $\ddot{x}$. This equation is obtained in the non-relativistic approximation by excluding the field from a system of electrodynamic equations. A.

538.566 : 621.392.1 = 82 396

Propagation of electromagnetic energy along a slot in a conducting plane. I. Travelling wave. PISTOLJKORS, A. A. *J. Tech. Phys., USSR*, **16** (*No.* 1) 11–20 (1946) *In Russian.*—[Abstr. 481 B (1947)].

538.566 : 621.392.1 = 82 397

Propagation of electromagnetic energy along a slot in a conducting plane. II. General case. PISTOLJKORS, A. A. *J. Tech. Phys., USSR*, **16** (*No.* 1) 21–34 (1946) *In Russian.*—[Abstr. 482 B (1947)].

MAGNETIC EFFECTS 538.6

538.614 : 541.57 : 549.211 398

The Faraday effect in diamond. RAMASESHAN, S. *Proc. Indian Acad. Sci. A*, **24**, 104–13 (*July*, 1946).—The magnetic rotation and Verdet constant for three thin cleavage plates and a natural crystal of diamond have been measured at different wavelengths in the visible. The magnetic rotation is proportional to the dispersion and follows the modified Becquerel formula with the multiplying factor, γ, constant at approximately 28%, a value considerably lower than recorded values for liquid carbon compounds. Sphalerite (ZnS), also investigated, gives 91% for γ. The deviation of γ from 100% is considered to be a measure of the extent to which the electron configuration departs from the inert gas structure, and low values indicate the covalent character of bonding. On this basis attention is drawn to the rather low values of γ for NaCl and KCl, and it is considered possible that the M–Cl binding may be at least partly covalent in character. W. R. A.

538.632 = 82 399

The effect of atomic arrangement on the Hall effect in the alloys $AuCu_3$ and AuCu. SIDOROV, S. *J. Exp. Theor. Phys.*, **16** (*No.* 6) 503–12 (1946) *In Russian.*

538.632 : 537.122 : 537.311.1 *see Abstr.* 337

538.632 : 537.311.33 400

The nature of the conductivity of KI crystals saturated with iodine. KALABUCHOV, N. *J. Phys., USSR*, **10** (*No.* 1) 61–3 (1946).—Experiments on the Hall effect in KI crystals saturated with iodine are described, showing that these crystals possess an electronic conductivity. A possible explanation of this conductivity is given. A.

538.632 : 537.311.1 : 537.122 *see Abstr.* 337

538.639 : 530.145 : 537.312.62 *see Abstr.* 344

538.66 401

Thermomagnetic and galvanomagnetic properties of conductors. III. GUREVICH, L. *J. Phys., USSR*, **10** (*No.* 2) 174–8 (1946).—[See Abstr. 346 (1947)]. Symmetry properties and temperature dependence of the coefficients involved are investigated in the general form. The Wiedemann–Franz law holds in any arbitrarily strong magnetic field for which the usual kinetic equation is valid. The Onsager symmetry relations are deduced for a case in which Onsager's derivation is invalid. The influence of carrying of electrons by phonons on Nernst's coefficient is clarified. A.

538.74 : 621.318.381 402

The correction of ships' magnetic compasses for the effects of degaussing. WASSELL, H. C., AND TURNER, D. A. *J. Instn Elect. Engrs, Pt I*, **93**, 518–24 (*Nov.*, 1946).—[Abstr. 409 B (1947)].

ATOMIC AND MOLECULAR STRUCTURE 539

539.11 : 539.152.1 *see Abstr.* 412

539.11 : 548.7 : 536.2.01 *see Abstr.* 317

539.132 : 541.57 = 82 *see Abstr.* 448

539.132 : 535.33 403

On the dissociation energies of CO, N_2, NO, and CN. VALATIN, J. G. *J. Chem. Phys.*, **14**, 568 (*Sept.*, 1946).

539.132 : 535.338.4–31 *see Abstr.* 284

539.132 : 541.57 404

The force constants of ozone. GLOCKLER, G., AND MATLACK, G. *J. Chem. Phys.*, **14**, 531–5 (*Sept.*, 1946).—A general valency force field treatment has been applied to the ozone molecule, in which it has been possible to obtain values for all four force constants. The values obtained, using a fundamental frequency assignment of Penney and Sutherland [Abstr. 4733, 4734 (1936)], are compared with values obtained from other assignments. In the light of present knowledge concerning the structure of the ozone molecule, the values used by Penney and Sutherland ($\omega_1 = 1\,043$, $\omega_2 = 710$, $\omega_3 = 1\,740$ cm^{-1}) are the most consistent, and the force constant of the oxygen–oxygen bond agrees better with the value predicted by Badger's rule than do the others. The oxygen–oxygen bond force constant in ozone lies in the range 0·75 to 0·99 megadyne. A.

539.133 405

Concerning effective interatomic distances in metals. GALPERIN, F. *J. Phys., USSR*, **10** (*No.* 2) 197 (1946).

539.133 : 541.552 406

Valence force and central force models for molecular vibrations. STEPANOV, B. *J. Phys., USSR*, **10** (*No.* 3) 243–51 (1946).—The very exact expressions of the potential energy obtained for CH_4, CH_3X, CH_2X_2, CHX_3, CX_4 in co-ordinates corresponding to the valence force and to the central force models allow the validity of both models to be compared. For molecules of hydrocarbons, the valence force model gives sufficiently good results. For molecules containing F, Cl and Br atoms, both models are invalid. An exact solution of the vibrational problem for these cases is required. A.

539.152.1 407

Nuclear induction. BLOCH, F. *Phys. Rev.*, **70**, 460–74 (*Oct.* 1 *and* 15, 1946).—The magnetic moments of nuclei in normal matter will result in a nuclear paramagnetic polarization upon establishment of equilibrium in a constant magnetic field. It is shown that a radio-frequency field at right angles to the constant field causes a forced precession of the total polarization around the constant field with decreasing latitude as the Larmor frequency approaches adiabatically the frequency of the r.f. field. Thus there results a component of the nuclear polarization at right angles to both the constant and the r.f. field and it is shown that under normal laboratory conditions this component can induce observable voltages. This nuclear induction is discussed, considering the effect of external fields only, and modifications are described which originate from internal fields and finite relaxation times. A.

539.152.1 408

The nuclear induction experiment. BLOCH, F., HANSEN, W. W., AND PACKARD, M. *Phys. Rev.*, **70**, 474–85 (*Oct.* 1 *and* 15, 1946).—The phenomenon of nuclear induction has been studied experimentally. The apparatus used is described, both as to principle and detail. Experiments have been carried out in which the signals from protons contained in a variety of substances were observed. The results show the role played by the relaxation time, which was found to vary between about 10^{-5} second and many seconds. A.

539.152.1 409

Spin magnetic resonance in the decimetre-wave region. ZAVOISKY, E. *J. Phys., USSR*, **10** (*No.* 2) 197–8 (1946).

539.152.1 410

A calculation of the binding energies of H^3 and He^4 with a new potential. WANG, M. H. *Phys. Rev.*, **70**, 492–4 (*Oct.* 1 *and* 15, 1946).—The binding energies of the nuclei are calculated by the method of equivalent two-body, using the potential suggested by Wang [Abstr. 643, 2368 (1945)]. The range at which the potential between two nucleons is cut off is the same as that for the case of the deuteron, and the same range for the equivalent two-body is deduced accordingly. The binding energies thus calculated are 7·3 MeV and 15·1 MeV, respectively. A.

539.152.1 : 537.123 411

On nuclear scattering of mesotrons. GINSBURG, V. *J. Phys., USSR*, **10** (*No.* 3) 297–8 (1946).

539.152.1 : 539.11 412

Nuclear magnetic resonance and spin lattice equilibrium. ROLLIN, B. V. *Nature, Lond.*, **158**, 669–70 (*Nov.* 9, 1946).—The absorption coefficient of radio-frequency energy by a substance in a magnetic field is proportional to the difference between the population of the magnetic energy states, and the r.f. field tends to equalize the population. This tendency is opposed by the spin-lattice coupling, which tends to restore thermal equilibrium with the lattice. By finding the magnitude of r.f. field required to produce an appreciable reduction in absorption coefficient, the relaxation time for transfer of energy from the nuclear spin system to the lattice can be calculated. Some preliminary experimental work on 2 and 16 Mc/s, at room and liquid air temperatures, is reported. Most proton-containing liquids appear to have a relaxation time of about 1 sec; in the solid state it is shorter.

539.153 : 535.331 *see Abstr.* 283

539.153.4 413

Internal conversion of magnetic multipole radiation. BERESTETZKY, V. *J. Phys., USSR*, **10** (*No.* 2) 137–43 (1946).—Formulae for the coefficient of internal conversion of magnetic multipole radiation in *K* and *L* shells are derived in non-relativistic approximation. A.

539.154.2 : 550.42 414

On the origin of the abundance distribution of chemical elements. KLEIN, O., BESKOW, G., AND TREFFENBERG, L. *Ark. Mat. Astr. Fys.*, 33 B (*No.* 1) *Paper* 1, 7 *pp.* (1946).—A statistical expression for the abundance of elements on the earth is derived using

a Gibbs grand ensemble with neutrons and protons as independent constituents and neglecting excited states and other small correcting factors. Numerical values are obtained by substituting in the expression the experimental values for mass defects. Results show general agreement with Goldschmidt's empirical abundance curve up to elements of atomic number about 60, but above this the theoretical curve falls away. Moreover, there are differences between the two curves in the region of low atomic number when a detailed comparison is made, but a qualitative explanation of these discrepancies is suggested.

W. E. D.

539.156 : 535.33 : 523.72 *see Abstr.* 194

RADIOACTIVITY . NUCLEAR DISINTEGRATION . NUCLEAR PARTICLES 539.16/.18

539.16.08 : 519.21 : 537.542 = 82 415

Statistics of misses in Geiger–Müller counters. BERLOVICH, E. *J. Exp. Theor. Phys.*, **16** (*No.* 6) 543–6 (1946) *In Russian.*—Some faults of existing theories of misses in simple records with Geiger–Müller counters are pointed out. A new formula is derived for computing corrections for misses.

539.16.08 : 519.21 : 621.318.572 = 82 416

The theory of misses in an electromagnetic numerator at the output of recording sets with Geiger–Müller counters. BERLOVICH, E. *J. Exp. Theor. Phys.*, **16** (*No.* 6) 547–52 (1946) *In Russian.*—A theory is given of corrections for misses in a scale-of-8 numerator. The formulae are applied to a real case for computing corrections; the misses in the numerator are compared with the misses in the counter circuit.

539.16.08 : 545.8 = 3 417

Radiometric analysis of U traces with unknown U : Ra ratio. ZIMENS, K. E., AND HEDVALL, J. A. *Ark. Kemi. Min. Geol.*, **22 A** (*No.* 6) *Paper* 25, 13 *pp.* (1946) *In German.*—The method now described avoids the usual assumption that Ra : U equilibrium has been attained and is therefore independent of the U : Ra ratio in the test material. The thorium isotope UX_1 is precipitated from strongly acid solution with $Na_2H_2P_2O_6$. Equilibrium with UX_2 is reached within a few minutes, and the β-radiation from this substance is measured, the counter being calibrated against known uranium sources. No other β-radiator is precipitated, and none is produced in this short time. The method is sensitive to 10^{-4} g and requires only that $U : UX_1$ equilibrium has been reached in the specimen, which is easily checked.

C. B. A.

539.164.93 418

The effects of radioactivity on fatty acids. SHEPARD, C. W., AND BURTON, V. L. *J. Amer. Chem. Soc.*, **68**, 1636–9 (*Aug.*, 1946).—To test the hypothesis that petroleum originates from the bombardment of paraffins by radioactive radiations emanating from sedimentary rocks, acetic acid vapour and solid caprylic, lauric and palmitic acids have been bombarded by α-particles. The gaseous products from each bombardment have been analysed, and contain mostly CO_2 and H_2, with small amounts of CO, H_2O, CH_4 and higher hydrocarbons. In addition, the products of the solid acids contain liquid and solid products; the liquid from lauric acid has physical properties close to those of *n*-undecane, and that from palmitic acid properties similar to those of *n*-pentadecane. Both these acids yield small amounts of water-soluble fatty acids. Several processes appear to be involved in the decomposition of a fatty acid molecule by α-particle bombardment, viz. dehydrogenation, decarboxylation, formation of low molecular weight water-soluble acids, formation of CH_4 and higher homologues, production of CO and H_2O, either directly or by the action of α-particles on CO_2 and H_2. Of these various processes, dehydrogenation and decarboxylation are the most predominant, and there is evidence that both processes do not occur in the same molecule. Fatty acids can be decarboxylated by α-particles to form hydrocarbons found in petroleum crudes. W. R. A.

539.164.93 419

The effects of radioactivity on a naphthenic acid. BREGER, I. A., AND BURTON, V. L. *J. Amer. Chem. Soc.*, **68**, 1639–42 (*Aug.*, 1946).—Irradiation of *cyclo*hexanecarboxylic acid with α-particles and with deuterons leads to the transformation of the acid into naphthenic constituents of crude oils, but the evidence is against the view that the *cyclo*hexane rings are opened as a result of the bombardment. W. R. A.

539.166.832 420

Intensities of γ rays, studied by means of their Compton secondaries. SIEGBAHN, K. *Proc. Roy. Soc. A*, **188** (*No.* 1015) 541–8 (1947).—Methods for investigating the γ-rays from active isotopes are discussed. A method is described which permits the study of very faint samples, and obtains information about the intensities as well as the energies. Such investigations necessitate knowledge of the efficiency curve for a secondary-electron radiator. With the aid of the known term schemes for Na^{24}, Mn^{56} and Cl^{38} an efficiency curve for Cu is constructed.

539.167.3 421

Excitation of indium 113 by X-rays. DUNWORTH, J. V., AND PONTECORVO, B. *Proc. Camb. Phil. Soc.*, **43**, 123–6 (*Jan.*, 1947).—The cross-section per nucleus for the production of In^{113*} with 2 MeV X-rays is of the same order as for the production of In^{115*}. The decay period of In^{115*}, for which some discrepancy was apparent in the literature, was definitely proved to be 4·5 hr. A.

539.185.7 422

On the scattering of low energy neutrons in helium II. AKHIESER, A., AND POMERANCHUK, I. *J. Phys., USSR*, **9**, 461 (1945).—The energy spectrum of helium II is assumed to be of the form given by Landau's theory [Abstr. 2532 (1942)]. It is shown that at temperatures lower than the transition point the scattering is negligibly small. A.

539.185.7 423

Scattering of fast neutrons by boron. BARSCHALL, H. H., BATTAT, M. E., AND BRIGHT, W. C. *Phys. Rev.*, **70**, 458–9 (*Oct.* 1 *and* 15, 1946).—The cross-section for the scattering through angles $>30°$ was measured at neutron energies between 0·2 and 3 MeV, and the results are presented in a table. A.

STRUCTURE OF SOLIDS 539.2

539.21 424

Physics and chemistry of swelling and shrinking. GEE, G. *Nature, Lond.*, **158**, 571–2 (*Oct.* 26, 1946).—Report of a discussion by the Faraday Society.

539.211 : 549.211 : 548.7 *see Abstr.* 459

539.214.9 : 532.517 = 82 *see Abstr.* 221

539.23 : 535.417 *see Abstr.* 308

539.26 : 539.4.016.2 : 548.73 *see Abstr.* 463

539.264 : 666.113.27 425

X-ray studies of noble metals dispersed in borax- and B_2O_3-glasses. MAJUMDAR, S. K., AND BANERJEE, B. K. *Nature, Lond.*, **158**, 753 (*Nov.* 23, 1946).

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.32 : 537.226 : 537.228.1 *see Abstr.* 334

539.374 426

Volume flow of plastic materials. LEE, A. R., REINER, M., AND RIGDEN, P. J. *Nature, Lond.*, **158**, 706 (*Nov.* 16, 1946).—A specimen of ashphalt was found to increase in volume by 2% while undergoing a linear extension of 7% under constant load. The fractured surface after breaking was rough, in contrast to the smooth appearance of an impact fracture [see Abstr. 2676 (1946)].

539.374 = 82 427

Plastic deformation and viscosity of ice. KOBEKO, P. P., SHISHKIN, N. I., MAREI, F. I., AND IVANOVA, N. S. *J. Tech. Phys., USSR*, **16** (*No.* 3) 263–72 (1946) *In Russian.*—Tests were carried out on Lake Suzdal and lakes near Leningrad, in tanks dropped into openings in the ice, diameters being 3, 4 and 8 m, water-depth 3 m and air temperatures −5 to −10°C, with uniform ice thicknesses from 1 to 10 cm. Ice temperatures were brought to 0°C by applying a covering of snow. Continuous records of the yield of the ice layer were obtained under static loading. Measurements were also taken on the natural 40 cm ice crust on Lake Suzdal, the load being applied by filling a 5 m³ water tank resting on the ice. Elastic deformation is illustrated by data for small loads (to 1 200 gm) on a 0·49 cm ice layer. The radius of elastic deformation appears as a function of layer thickness, and is independent of the load. Comparative data are given for plastic deformation over periods up to 100 min, and, in some tests, up to 8 days. The curves show deformation as a function of distance from the point of application. Deformation proceeds linearly with time, except for ice temperatures below 0°C. Elastic deformation comprises 0 to 5% of the overall deformation. For a 40 cm layer, elastic deformation affects a radius of 25 m, and plastic deformation 5 m. The data are examined on the basis of several formulae, which are given. Safe limits for stationary loads are calculated.

R. M.

539.374 : 548.7 = 82 428

Investigation of the Wood and Smith effect. DAVIDENKOV, N. N., AND TIMOFEEVA, M. N. *J. Tech. Phys., USSR*, **16** (*No.* 3) 283–90 (1946) *In Russian.*—For the purpose of investigating the theory of residual variation in the parameters of the crystal lattice after uniform plastic deformation, as propounded by Wood and Smith, experiments were carried out for measuring the residual strain in the surface layers of plastically distended samples, consisting of sheet Al and sheet duralumin plated with Al. Measurements were taken on one surface of the specimen, pre-treated with NaOH solution. No sign of residual strain was observed in seven series comprising: basic tests on Al specimens; tests in which caustic soda treatment was confined to an area down the centre of the specimen surface; samples having various grain size; tests with different thicknesses of layer removal; investigation of the influence of caustic treatment on the mechanical properties of the surface; samples subjected to thermal treatment in vacuum; and experiments for investigating the influence of tempering temperature on the uniformity of the specimen properties throughout its thickness. A further series of tests for checking the method on non-uniform specimens of duralumin plated with Al confirmed the initial assumption. The conclusion is drawn that the residual parameter variation claimed by Wood is either a characteristic of the crystallite or arises from the specific condition of the experiment.

R. M.

539.377 : 669 429

The anisotropy of thermal expansion as a cause of deformation in metals and alloys. BOAS, W., AND HONEYCOMBE, R. W. K. *Proc. Roy. Soc. A*, **188** (*No.* 1015) 427–39 (1947).—Plastic deformation produced by repeated heating and cooling of certain non-cubic metals has been studied from −190 to 250°C. The extent of the deformation which results from the anisotropy of thermal expansion of individual crystals becomes greater as the temperature range is increased. In the case of Cd, plastic deformation was detected even after 20 cycles over the temperature range 30–75°C; in cyclic treatment to higher temperatures the deformation was associated with extensive grain-boundary migration. Cyclic treatment of Sn, Cd and Zn between room temperature and that of liquid air resulted in complex slipping and twinning, but grain-boundary migration was practically absent. Cooling from the liquid state, which represents half a thermal cycle, sets up stresses in metals possessing anisotropy of thermal expansion, and leads to plastic deformation. This is shown by the detection of slip lines and grain-boundary accentuation in certain cast non-cubic metals. In Cd, subsequent annealing results in marked grain growth. Experiments were carried out with a series of Sn-rich Sn–Sb alloys, the majority consisting of the Sn-rich matrix in which particles of a hard second phase of cubic crystal structure were embedded. It was found that the deformation in the region of the boundaries between crystals of the two phases was considerably smaller than in the region of the crystal boundaries of the anisotropic matrix. Similar results were obtained with Sn-base bearing alloys. A.

539.4.016.2 : 539.26 : 548.73 *see Abstr.* 463

539.412 : 677.1 = 4 430

Elastic properties of textile fibres. CHEVENARD, P., AND CHAMPETIER, G. *C.R. Acad. Sci., Paris*, **222**, 954–7 (*April* 15, 1946) *In French.*—Measurements of

Young's modulus (Y) by the authors' micromechanical (dynamometric) method, using a photographic recorder which magnifies the stretch 40–60 times, indicate that the linkages connecting the $-CO$, $-CH_2$ and $-NH$ groups of nylon form a regular zig-zag pattern analogous to that formed by a distorted metallic wire. Permanent deformation reduces the cross-section and increases the fibre length. With stretched nylon, Y increases 4 times between zero load and rupture, but with silk and ramie (in which the H linkages between the long chains are more numerous than those of nylon) the increase is much less, indicating a spiral type of structure. With keratin, however, Y decreases and the mechanical hysteresis increases; the reason for this is, as yet, unexplained.

J. G.

539.42 431

Spiral cracks in glass tubes. HOPFIELD, J. H. *Nature, Lond.*, **158**, 582–3 (*Oct.* 26, 1946).—Thick-walled Pyrex capillary tubing heated to 500–600°C develops a spiral crack when plunged into water. The closeness of the spiral increases for higher temperatures.

539.42 = 82 432

Breakdown and carrying capacity of ice. KOBEKO, P. P., SHISHKIN, N. I., MAREI, F. I., AND IVANOVA, N. S. *J. Tech. Phys., USSR*, **16** (*No.* 3) 273–6 (1946) *In Russian.*—Experimental data are presented showing the dependence of the breaking load on ice thickness and distribution of the load, for brief application. Loads of 0·5 to 30 000 kg were applied to ice layers 0·15 to 40 cm thick by ebonite and metal discs of diameters 5 and 20 cm, and 20 to 65 cm square plates. It was observed generally that breaking load increased to double with increase in area of application to 200 times. The relationship of breaking load to thickness is expressed by the equation: $P = \alpha h^2$ (P = load in kg; $\alpha = 20$; h = thickness in cm). Air temperature variations from 0° to 20°C did not seriously affect the results. The data show that the total limiting deformation (plastic + elastic) is approximately the same for both rapid application of the load (max. elastic deformation) and gradual application (max. plastic deformation). R. M.

539.501 : 532.517 433

Rheological properties of high-viscosity solutions of long molecules. GARNER, F. H., AND NISSAN, A. H. *Nature, Lond.*, **158**, 634–5 (*Nov.* 2, 1946).—The macromolecules of a strained elastic solid depart from their most probable form with a consequent decrease in entropy. In a liquid, the groups of molecules have freedom to increase their entropy by moving to regions of less strain. Experiments are described in which this tendency is demonstrated: (1) Abnormally high surface tension of expanding jets. (2) Abnormally high "inlet pressure loss" in pipes leading from reservoirs. (3) Apparent increase of viscosity with radial distance for flow in pipes. (4) "Secondary flow" phenomena depending on the space derivatives of the rate of strain, rather than of the strain or stress themselves.

539.61 : 532.696.1 = 82 434

Wetting and strength of adhesion. KOBEKO, P. P., AND MAREI, F. I. *J. Tech. Phys., USSR*, **16** (*No.* 3) 277–82 (1946) *In Russian.*—De-icing problems are studied on the basis of an experimental investigation on a number of wetting combinations (copper–mercury, copper–mercury amalgam, copper–water, glass–water and iron–water) and non-wetting combinations (glass–mercury, iron–mercury and polystyrol–water). Results obtained from the first seven combinations show that the strength of adhesion on freezing is not a function of the type of material or liquid, or of the wetting character of the combination. Values of approximately 20 kg/cm² were obtained throughout, except for the polystyrol–water combination, for which a value of 2·2 kg/cm² was obtained. On adding a wetting reagent, complete wetting was obtained, but the strength of adhesion remained unchanged. Similar behaviour was observed with other plastics (polymethyl methacrylate, ebonite and escapon) and varnishes. Plastics and varnishes in combination with non-crystallizing liquids such as engine oil provided adhesion strengths around 20 kg/cm². Hence methods for countering icing by the application of coatings are discounted.

R. M.

PHYSICAL CHEMISTRY 541

CHEMICAL EQUILIBRIUM 541.121/.123

541.123 435

Note on the conditions of equilibrium for systems of many constituents. BRINKLEY, S. R., JR. *J. Chem. Phys.*, **14**, 563–4 (*Sept.*, 1946).—An analytical criterion is given for the choice of independent components. An inclusive discussion of equilibrium in systems of many constituents is thereby achieved. By reason of symmetry, the resulting conditions are particularly suited to form the basis of a calculation of the equilibrium composition of the system. A.

REACTION KINETICS 541.124/.128

541.124 436

The kinetics of the reactions of the steam–carbon system. GADSBY, J., HINSHELWOOD, C. N., AND SYKES, K. W. *Proc. Roy. Soc. A*, **187**, 129–51 (*Oct.* 22, 1946).

541.126 437

The mechanism of the hydrogen–oxygen reaction. IV. The activation energy of the initiating process. V. The reaction in vessels coated with alkali iodides. CULLIS, C. F., AND HINSHELWOOD, C. N. *Proc. Roy. Soc. A*, **186** (*No.* 1007) 462–72 (*Sept.* 24, 1946).

541.127.1 : 542.952.6 *see Abstr.* 452

541.127.1 : 542.952.6 : 541.144 *see Abstr.* 440

541.128.1 438

Kinetics of the base-catalysed bromination of diethyl malonate. BELL, R. P., EVERETT, D. H., AND LONGUET-HIGGINS, H. C. *Proc. Roy. Soc. A*, **186** (*No.* 1007) 443–53 (*Sept.* 24, 1946).

ELECTROCHEMISTRY 541.13

541.132.3 : 621.317.723 439

A direct-reading *p*H meter. THORP, R. H. *Electronic Engng*, **17**, 671–5 (*Sept.*, 1945).—A brief survey of the technique of measuring *p*H with a glass electrode and an electrometer is given and the difficulties arising from the high internal resistance of the electrode explained. A novel type of electrometer is described which depends upon the grid current of the electrometer valve maintaining a small but constant value. A triode-connected EF36 operating at 45–90 V on the anode is satisfactory. The mutual conductance is 2·8 mA/V and an operating point can be chosen to give linear current change over a range of 14 *p*H units, on a 6-in scale backed-off meter.

H. G. M. S.

PHOTOCHEMISTRY 541.14

541.144 : 541.127.1 : 542.952.6 440

The photochemical polymerization of methyl vinyl ketone vapour. JONES, T. T., AND MELVILLE, H. W. *Proc. Roy. Soc. A*, **187**, 19–36 (*Oct.* 8, 1946).

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.182.2 : 536.423.1 : 532.694 *see Abstr.* 234

ADSORPTION 541.183

541.183 441

On filtration through a sorbent layer. I. An attempt at a simple mathematical treatment. SILLÉN, L. G. *Ark. Kemi. Min. Geol.*, **22 A** (*No.* 5) *Paper* 15, 22 *pp.* (1946).—If a gas or solution containing small amounts of a substance A is filtered through a sorbent layer, its sorption may be formally written as a reaction between A and molecules B in the sorbent: $A + B(\text{"hole"}) \rightarrow AB$ (sorbed molecule). Equations are thus derived which express the concentrations $[A]$ and $[B]$ as functions of the distance x from the beginning of the layer, and a corrected time. The cases successfully considered are: (1) sorption irreversible and bimolecular (rate $\propto [A]\,[B]$), where it is shown that the isochrones move in the positive x-direction with a definite velocity; and (2) reversible sorption; but it has not been possible to obtain equations for pure desorption. S. J. G.

541.183 442

On filtration through a sorbent layer. II. Experiments with an ion exchanger; theory, apparatus and preliminary results. SILLÉN, L. G., AND EKEDAHL, E. *Ark. Kemi. Min. Geol.*, **22 A** (*No.* 5) *Paper* 16, 12 *pp.* (1946).—The equations in Part I are modified to apply to the present case where Ag^+ ions are filtered through an organic cation exchanger X. X, contained in a cylindrical filter funnel, is first charged with H^+ ions by passing a stream of HNO_3 through it, and $AgNO_3$ solution is then run through. The concentration of Ag^+ ions leaking through, $[Ag^+]$ is measured by an Ag/AgI electrode. It is shown that $[Ag^+]$ and the amount of Ag^+ adsorbed ($[Ag]_{solid}$) approach a final function only if $[Ag^+]_{solid}[H^+]/[H^+]_{solid}[Ag^+] > 1$. Experimental results agree reasonably with the theoretical equations.

S. J. G.

541.183 : 621.317.39 : 621.316.71.078.4 443

An automatically recording electrical sorption balance. GREGG, S. J., AND WINTLE, M. F. *J. Sci. Instrum.*, **23**, 259–64 (*Nov.*, 1946).—Details of an automatic controlling and recording device for attachment to an electrical sorption balance are given. The device automatically plots, against time, the change in mass of a solid adsorbent or reactant when this is exposed to a vacuum or to a known pressure of gas. As the mass changes the balance beam is automatically brought to its null position by alteration of the current flowing through a control solenoid: photo-electrically operated relays adjust the position of a wiper moving along a potentiometer, uniformly wound and carrying a stabilized voltage; the voltage picked up on the wiper is used to control the balance. The position of the wiper is marked on a revolving drum and its displacement is proportional to the change of mass. A damping circuit is incorporated to avoid violent overswings of the balance beam. A.

541.183.3 444

The application of the hanging-plate method to the study of monomolecular films at the liquid–liquid interface. CHEESMAN, D. F. *Ark. Kemi. Min. Geol.*, **22 B** (*No.* 6) *Paper* 1, 8 *pp.* (1946).—The "plate" is a standard microscope slide notched so as to hang freely from the prongs of a glass fork attached to one pan of a chainomatic balance. A strip at the bottom of the plate is rendered hydrophobic by covering with carbon deposited from a benzene flame. The plate dips into a cylindrical glass dish 12×2 cm containing CCl_4 to 8 mm depth, and H_2O on top; the carbon-covered surface gives $\theta = 0$ (θ = receding contact angle) in the interface and the "clean" glass $\theta = 0$ at the water surface. The film-forming material (a protein dissolved in propyl alcohol and sodium acetate) is injected into the interface by a calibrated micrometer syringe. The force-area curves for lecithin and globulin are rather similar to the corresponding curves for the air–water interface except that the protein may be compressed to smaller areas before collapse (e.g. lecithin to 40 Å²). S. J. G.

541.183.36 : 536.42 445

The adsorption of vapours on mercury. I. Non-polar substances. KEMBALL, C., AND RIDEAL, E. K. *Proc. Roy. Soc. A*, **187**, 53–73 (*Oct.* 8, 1946).—Experiments were made to determine (1) the nature of the monolayer films formed on Hg, (2) the conditions governing the formation of multilayers or lenses on Hg, (3) the quantitative energies of adsorption of simple molecules on Hg which give the magnitude of the van der Waal's or exchange forces involved. Reversible results for the adsorption of benzene, toluene and *n*-heptane vapours were obtained. The films are gaseous and obey the equation $F(A - b) = kT$, where F is the spreading pressure, A is the area per molecule and b the co-area. A

standard state for the surface phase was defined and the free energy, total energy and entropy of adsorption were evaluated. Some phase changes occur after the completion of monolayer adsorption, e.g. the change from "flat" to "vertical" adsorption of the toluene molecules. L. S. G.

541.183.36 : 536.658 : 536.75 446

The adsorption of vapours on mercury. II. The entropy and heat of adsorption of non-polar substances. KEMBALL, C. *Proc. Roy. Soc. A*, **187**, 73–87 (*Oct.* 8, 1946).—Calculations were made of the entropy of adsorption and, in the case of benzene, of the heat of adsorption. These indicate the amount of translational and rotational freedom possessed by the substances on the surface of Hg. The theoretical heat of adsorption of benzene was derived from various relations for the attractive and repulsive potentials for the van der Waal's forces near a metal surface. The agreement with experiment is good and the calculations give some idea of the ranges of intermolecular distance over which the different equations for the attractive potential were accurate. L. S. G.

541.183.56 447

The activated adsorption of nitrogen on a finely divided tungsten powder. DAVIS, R. T. *J. Amer. Chem. Soc.*, **68**, 1395–1402 (*Aug.* 15, 1946).

CHEMICAL STRUCTURE 541.4/.6

541.552 : 539.133 *see Abstr.* 406

541.57 : 539.132 *see Abstr.* 404

541.57 : 539.132 = 82 448

On the theory of the hydrogen bond. GUBANOV, A. *J. Exp. Theor. Phys.*, **16** (*No.* 6) 523–7 (1947) *In Russian.*—It is shown that the basis of the hydrogen bond is not resonance of valency structures, but electrostatic interaction, due to the absence of any electron structure in hydrogen. This conclusion agrees with experimental data. A.

541.57 : 549.211 : 538.614 *see Abstr.* 398

541.6 449

Electron diffraction investigation of the molecular structure of thioacetic acid. GORDY, W. *J. Chem. Phys.*, **14**, 560–2 (*Sept.*, 1946).

541.67 450

Diamagnetic susceptibility of isomerides. ANGUS, W. R., AND STOTT, G. *Nature, Lond.*, **158**, 705 (*Nov.* 16, 1946).—Further results [see Abstr. 2369 (1943)] show that isomerides do not have identical susceptibilities.

541.68 : 532.13 *see Abstr.* 219

CHEMICAL APPARATUS 542.1/.7

542.2 (43) 451

Chemical laboratory instrumentation in Germany. *BIOS Rep* (*No.* 736) (*H.M. Station. Off.*; *U.S. Dep. Comm.*) 28 *pp.* (1946).

CHEMICAL PROCESSES 542.9

542.952.6 : 541.127.1 452

The free radical polymerization of the vapours of certain vinyl derivatives. JONES, T. T., AND MELVILLE, H. W. *Proc. Roy. Soc. A*, **187**, 37–53 (*Oct.* 8, 1946).

542.952.6 : 541.127.1 : 541.144 *see Abstr.* 440

CHEMICAL ANALYSIS 543/545

543.812 : 621.317.39 453

The determination of the moisture content of cereals by measurement of specific inductive capacity. GROVES, L. G., AND KING, J. *J. Soc. Chem. Ind.*, **65**, 320–4 (*Oct.*, 1946).—[Abstr. 380 B (1947)].

545.71 : 621.317.39 454

Applications of the thermal conductivity gas analyser. BIALOUS, A. J., AND HANSEN, C. A. *Gen. Elect. Rev.*, **49**, 20–6 (*Oct.*, 1946).—The equilibrium temperature of an electrically heated wire depends on the thermal conductivity of the surrounding gas, whose composition can be estimated if the resistance-temperature curve of the wire is known. Two identical cells, fitted with W filaments, are connected in two arms of a Wheatstone bridge, the other two arms being manganin resistances. One cell is sealed and contains a gas of known properties, while the unknown gas is passed slowly through the other cell. The cells are fitted into a block of metal, maintained at a constant temperature. An indicating or recording galvanometer is connected across the bridge and there is a milliammeter and variable resistance in the battery circuit. The out-of-balance deflection depends on the unknown constituents and is a direct indication of their ratios. This method is non-destructive, requires only a small sample, has a response time of 6 sec to 2 min, depending on the conditions, will give a continuous record and requires comparatively little attention. It is not suitable for detecting traces of one gas in another, or for systems of more than two gases, except under special circumstances. Typical applications are flue gas analysis; O_2 and CO_2 measurements in respiratory experiments; gas or vapour analysis and control in the chemical and electro-chemical industries; atmosphere analysis in heat processing plants; for the detection of "fire-damp"; testing balloon fabric; food preservation, etc. E. H. D.

545.8 : 539.16.08 = 3 *see Abstr.* 417

CRYSTALLOGRAPHY 548

548.0 : 538.114 *see Abstr.* 383

548.1.021 : 548.736.15 : 549.211 455

On the crystal symmetry of diamond and its X-ray reflections. RAMACHANDRAN, G. N. *Proc. Indian Acad. Sci. A*, **24**, 58–64 (*July*, 1946).—Theoretical. The presence or absence of the 200 or the 222 reflection cannot decide uniquely between tetrahedral and octohedral symmetry. The 200 reflection will be

absent if the structure is either completely symmetric or anti-symmetric with respect to the centre of inversion at $\frac{1}{8}, \frac{1}{8}, \frac{1}{8}$, or if the two distributions are superposed in an arbitrary ratio. The 222 reflection will be absent only in the fully symmetric case. On the basis of these results the nature of the structures that are possible for the tetrahedral and octohedral modifications of diamond have been discussed.

W. R. A.

548.232.2 : 535.543 : 549.211 456

On the nature and origin of the laminations observed in diamond. RAMACHANDRAN, G. N. *Proc. Indian Acad. Sci. A*, **24**, 65–81 (*July*, 1946).—The birefringence patterns of many plates of diamond show sets of bright parallel streaks which have been attributed to the existence of definitely orientated laminations inside the crystal which are under strain. These laminae show up most clearly when the light beam passes parallel to them inside the crystal, and properly inclined plates display the laminary effects even if they do not exhibit any streaks when viewed normally. The orientations of the laminae have been fixed from measurements with the Federov stage and X-rays, and are generally parallel to octahedral or dodecahedral planes. Laminations in more than one direction may be exhibited by the same diamond. The birefringence of the laminae have been quantitatively determined by a Babinet compensator, and they usually behave either as a positive or a negative uniaxial crystal with the optic axis normal to them. They usually have a thickness between 10 μ and 100 μ and the order of birefringence varies from 0·00006 to 0·0003. U.v.-opaque diamonds give octohedral laminae of the transparent diamond having either positive or negative birefringence (sometimes both), whereas u.v.-transparent diamonds are completely laminated with alternate positive and negative laminae. These results favour the Raman view that there are two varieties of u.v.-transparent diamonds which differ from each other and from u.v.-opaque specimens, and that one has a larger and the other a smaller lattice spacing than the opaque variety. Orientated laminae have also been exhibited in luminescence.

W. R. A.

548.571 : 549.211 457

The crystal forms of diamond and their significance. RAMAN, C. V., AND RAMASESHAN, S. *Proc. Indian Acad. Sci. A*, **24**, 1–24 (*July*, 1946).—A critical examination of 72 diamonds from various sources has been made and it is considered from the curvature of their faces and other special features that the forms of diamond cannot be described in the standard terms of geometric crystallography, but must be described and classified by the configuration of the sharply-defined edges which appear dividing the superficies of the crystal into 24 distinct sections. These edges usually lie along the intersections of the surface with the symmetry planes of a fundamental tetrahedron. These planes contain the directions of the valency bonds between carbon atoms in the crystal and the sharpness of the edges is determined by the angle which they make with the valency directions. The configuration and specific features of edges prove that the crystal symmetry of most diamonds is of the tetrahedral class, and crystallographic evidence shows that positive and negative tetrahedral forms interpenetrate. This explains why forms frequently appear common to the tetrahedral and octahedral symmetry classes, but does not preclude the possibility of occasional diamonds possessing a true octahedral symmetry. The formation of diamond is explained by a physical theory which is in keeping with observed facts and enables diamonds to be classified in a regular sequence.

W. R. A.

548.571 : 549.211 458

A theory of the crystal forms of diamond. RAMASESHAN, S. *Proc. Indian Acad. Sci. A*, **24**, 122–9 (*July*, 1946).—A semi-quantitative form has been given to Raman's theory of the crystal shapes of diamond on the basis of calculations of cleavage energies [see Abstr. 459 (1947)].

W. R. A.

548.7 : 537.122 : 537.311.1 *see Abstr.* 338, 339

548.7 : 539.11 : 536.2.01 *see Abstr.* 317

548.7 : 539.211 : 549.211 459

The cleavage properties of diamond. RAMASESHAN, S. *Proc. Indian Acad. Sci. A*, **24**, 114–21 (*July*, 1946).—Calculations of the cleavage epergies of various planes in diamond have indicated the presence of cleavages other than those already known, and goniometric investigation of crystal fragments has established the presence of the following: (111), (221), (110), (322), (331), (211), and (332), with (111) the most perfect and abundant. The (111) cleavage has minimum cleavage energy and is bounded on either side by layers of atoms having three times the cleavage energy. Diamond has curved fractures also in accordance with the theory developed.

W. R. A.

548.7 : 539.374 = 82 *see Abstr.* 428

548.7 : 549.211 : 535.343.2–15 *see Abstr.* 287

548.7 : 549.211 : 535.375.5 *see Abstr.* 300, 301

548.7 : 549.514.51 460

Surface layers on quartz and topaz. D'EUSTACHIO, D. *Phys. Rev.*, **70**, 522–8 (*Oct.* 1 *and* 15, 1946).—X-ray studies of single crystals of quartz and topaz show that there exist on the surfaces of these crystals disturbed layers which are not removed by etching, and that they exert an effect on etched surfaces to a depth of 5 or more microns. The disturbance is not caused by plastic flow. Good, single crystal quartz wafers, 35 microns thick, change when they are etched to 15 microns. The thin plates no longer appear to be single crystal. This "polycrystalline" state is stable at room temperature. Thin crystals undergo further changes when flexed, resulting in a two or threefold broadening of the Cu $K\alpha$ rocking curves. Similar results were observed with topaz. It is shown that this effect is different from, and may not be related to, the well-known broadening of the Bragg reflections that result from grinding crystal surfaces. It is suggested that at least part of the surface energy is in the form of structure irregularity, and there results a very thin, glass-like layer that is unstable because it is effectively at a higher temperature than the rest of the crystal. Consequently, recrystallization to a more stable form occurs.

548.73 461

Correction of diffraction amplitudes for Lorentz and polarization factors. BUERGER, M. J., AND KLEIN,

G. E. *J. Appl. Phys.*, **17**, 743 (*Sept.*, 1946).—Erratum [see Abstr. 1738 (1946)].

548.73 462

Statistical structure of ice and of ammonium fluoride. LONSDALE, K. *Nature, Lond.*, **158**, 582 (*Oct.* 26, 1946).—X-ray diffraction diagrams of ice show strong diffuse streaks connecting regions of the reciprocal lattice which have structure factors of different sign [see Abstr. 3243 (1946)]. These are temperature-dependent, and must be attributed to vibratory movements of the hydrogen nuclei. It is suggested that the unit cell given by X-ray analysis is only the statistical unit, and the instantaneous configuration is more complex. The change from one configuration to another takes place by group movements of hydrogen nuclei from one oxygen atom to another. Similar patterns are found with ammonium fluoride.

548.73 : 53.081 *see Abstr.* 197

548.73 : 535.3 : 537.531 *see Abstr.* 354

548.73 : 539.4.016.2 : 539.26 463

X-ray examination of self-recovery in copper. MILLER, J. L., BANNISTER, L. C., AND HINDE, R. M. *Nature, Lond.*, **158**, 705–6 (*Nov.* 16, 1946).—[See Abstr. 1396 (1946)].

548.73 : 549.211 464

X-ray topographs of diamond. II. RAMACHANDRAN, G. N. *Proc. Indian Acad. Sci. A*, **24**, 95–103 (*July*, 1946).—[See Abstr. 2642 (1944)]. From the study of X-ray topographs of a number of diamonds the following results, explainable by the Raman theory of the structure of diamonds, have been found: (1) In purely blue-luminescent diamonds there is a direct correlation between intensity of luminescence and X-ray reflecting power. (2) Non-luminescent diamonds show parallel bands, corresponding often with bands in the birefringence patterns and suggesting occasional occurrence of considerable mis-orientations of fairly large crystal blocks. (3) The topographs of diamonds exhibiting both yellow and blue luminescence show a correspondence only with the yellow luminescence pattern if the two are different, and with both if they are similar. The investigation of the orientation of a number of cleavage plates revealed that the majority were of octahedral cleavage, but some had their large faces parallel to the (211) plane. W. R. A.

548.73 : 549.211 : 536.413 *see Abstr.* 319

548.73 : 549.514.51 : 621.396.611.21 465

X-ray studies of surface layers of crystals. ARMSTRONG, E. J. *Bell Syst. Tech. J.*, **25**, 136–55 (*Jan.*, 1946).—Methods and the information obtained by their use are reviewed with particular application to quartz oscillator plates. Reflection-intensity measurements on the single crystal spectrometer with the ionization chamber give a measure of the amount of disturbed material differing in orientation from the main plate by less than a few minutes. The frequency distribution with angle of this disturbed material can be determined with a double crystal spectrometer, and its coarseness with the transmission Laue camera. The extent of appreciable misalignment, up to 6°, is determined by photographic recording of reflections obtained on the single crystal spectrometer with the crystal placed at successive small increments from the position of the maximum reflected intensity. The distribution of disturbance is revealed by a broad X-ray beam reflected from the crystal surface on to a parallel plate or film. Only by electron diffraction methods can randomly oriented powder, removable by scrubbing, be detected. It is shown by etching experiments that the thickness of material misoriented by more than a minute is about $\frac{1}{2}\mu$ and that of the small-angle disturbed material may be 50–100 μ. 38 references are given. P. O.

548.733 466

Rotating sample holder for X-ray diffraction studies. CHAMPAYGNE, E. F. *Rev. Sci. Instrum.*, **17**, 345 (*Sept.*, 1946).

548.734.82 467

Correction of X-ray powder diffraction films for non-uniform shrinkage. CLAASSEN, H. H., AND BEU, K. E. *Rev. Sci. Instrum.*, **17**, 307 (*Aug.*, 1946).

548.735.46 468

Synthetic Patterson maps. BOOTH, A. D., AND WRINCH, D. *J. Chem. Phys.*, **14**, 503–4 (*Aug.*, 1946).—Comparison of calculated and observed Patterson syntheses is proposed as a test of the correctness of a crystal structure, to replace the usual comparison of calculated and observed structure amplitudes, especially in complex structures. A point Patterson is easily constructed for the proposed positions of the atomic centres, and each point is replaced by a density distribution depending on the Fourier transform of the electron density in the atoms. If the electron density is represented by the empirical formula $N(p/\pi)^{3/2} \exp(-pr^2)$, where N is the atomic number and p is about 4·69, the density distribution required for the Patterson is $N^2(p/2\pi)^{3/2} \exp(-\frac{1}{2}pr^2)$. A. J. C. W.

548.736 : 537.311.33 *see Abstr.* 341

548.736.1 469

A redetermination of the lattice constant of lead. KLUG, H. P. *J. Amer. Chem. Soc.*, **68**, 1493–4 (*Aug.*, 1946).—Using lead at least 99·999% pure, the value of the lattice constant at 25° is 4·9408 ± 0·0001 *kX* units. W. R. A.

548.736.1 470

Investigations of lattice defects by means of X-rays. IV. The diffuse pattern of tin single crystals. BOUMAN, J., ARLMAN, J. J., AND VAN REIJEN, L. L. *Physica, 's Grav.*, **12**, 353–70 (*Sept.*, 1946).—The diffuse streaks on a Laue photograph of tin are now considered in the light of the thermal theory [Abstr. 2362, 2364 (1942)]. The calculation, starting from the elastic constants of tin, shows a rather good agreement with the observed streaks. A small discrepancy may indicate that the assumed value for at least one of the constants is wrong.

548.736.1 471

The lattice spacings of lithium at 20°C and −183°C. LONSDALE, K., AND HUME-ROTHERY, W. *Phil. Mag.*, **36**, 799–801 (*Nov.*, 1945).—The lattice spacings were determined independently by the authors, and each obtained the same value at 20°C, $a = 3{\cdot}5023\,kX$, with an error likely not to exceed $\pm 0{\cdot}0002\,kX$. The value at −183°C is $a = 3{\cdot}4762\,kX$. These values were obtained with the latest extrapolation methods

[Abstr. 2586 (1945)] and are an improvement on values obtained earlier [Abstr. 2302 (1940)]. L. S. G.

548.736.1 : 536.413.2 472

The lattice spacing of rubidium between −183°C and +19°C. HUME-ROTHERY, W., AND LONSDALE, K. *Phil. Mag.*, **36**, 842–5 (*Dec.*, 1945).—The lattice spacing was found to be 5·624 *kX* at −183°C and 5·698 *kX* at 19°C. These are more accurate results than were obtained previously. Data are also given for the mean coefficients of linear expansion over certain ranges of temperature. It is found that the coefficient decreases slowly over the range +19°C to −183°C, and has a mean value of $6 \cdot 6 \times 10^{-5}$ over the range +19°C to −97·5°C. L. S. G.

548.736.1 : 536.424.1 473

The crystal structure of polonium. BEAMER, W. H., AND MAXWELL, C. R. *J. Chem. Phys.*, **14**, 569 (*Sept.*, 1946).—Polonium undergoes a phase transformation at about 75°C, which is evidenced by an abrupt change of electrical conductivity of a thin film. Preliminary X-ray diffraction powder diagrams have been taken of the two forms. In an earlier investigation [Abstr. 4963 (1936)] a mixture of the two forms appears to have been used.

548.736.15 : 549.211 : 548.1.021 *see Abstr.* 455

548.736.182 : 549.212 474

Structure of graphite. GIBSON, J. *Nature, Lond.*, **158**, 752 (*Nov.* 23, 1946).—Powder photographs of graphite have been obtained (an example is shown) containing lines which cannot be explained on the structure proposed by Lipson and Stokes [Abstr. 3105 (1942)].

548.737 475

Crystal structure of zinc *p*-toluenesulphonate. HARGREAVES, A. *Nature, Lond.*, **158**, 620–1 (*Nov.* 2, 1946).—This has been determined by the direct method of Fourier synthesis, making no assumptions about the stereo-chemistry. A contour map of electron density is given, and a structure diagram deduced from it. The unit cell dimensions are $a = 25 \cdot 3$; $b = 6 \cdot 2_9$; $c = 6 \cdot 9_8$ Å; $\beta = 88 \cdot 5°$. The corresponding values for the Mg salt are 25·2, $6 \cdot 2_6$, $6 \cdot 9_5$, 88·1°. Space group: $P2_1/n(C_{2h}^5)$.

549.12 : 535.822.9 476

Phase contrast microscopy for mineralogy. SMITHSON, F. *Nature, Lond.*, **158**, 621 (*Nov.* 2, 1946).

549.211 : 535.371 *see Abstr.* 293–7

549.211 : 535.377 *see Abstr.* 303

549.211 : 535.543 : 548.232.2 *see Abstr.* 456

549.211 : 537.312.5 *see Abstr.* 343

549.211 : 539.211 : 548.7 *see Abstr.* 459

549.211 : 541.57 : 538.614 *see Abstr.* 398

549.211 : 548.571 *see Abstr.* 457, 458

549.211 : 548.7 : 535.343.2–15 *see Abstr.* 287

549.211 : 548.7 : 535.375.5 *see Abstr.* 300, 301

549.211 : 548.73 *see Abstr.* 464

549.211 : 548.73 : 536.413 *see Abstr.* 319

549.211 : 548.736.15 : 548.1.021 *see Abstr.* 455

549.212 : 548.736.182 *see Abstr.* 474

549.514.51 : 548.7 *see Abstr.* 460

549.514.51 : 621.396.611.21 477

Interrogation of German scientists regarding quartz crystals and other piezoelectric materials. *FIAT Rep.* (*No.* 641) (*H.M. Station. Off.*; *U.S. Dep. Comm.*) 21 *pp.* (1946).—The synthesis of quartz by Nacken appeared to have considerable promise; it is based on the differences in solubility of crystalline quartz and vitreous silica, the latter being more soluble at all temperatures, and above 350°C the ratio is 10 : 1. The following features of Nacken's method are discussed: the autoclaves, the seed and its suspension, the nuclear inhibitors, and the furnace. Nacken stated that any piece of crystalline quartz would serve as a seed and that new growth would follow the same orientation as the seed, and if the seed were twinned the new quartz would be likewise twinned. The German wartime quartz industry was not highly organized, the principal improvement being the conservation of raw quartz by drastic reduction in the size of oscillator plates. H. H. HO.

549.514.51 : 621.396.611.21 : 548.73 *see Abstr.* 465

GEOPHYSICS 55

550.341 : 534.222 = 5 478

On the relation between the coefficient of absorption and the period of seismic waves. VALLE, P. E. *Ric. Sci. Ricostruz.*, **16**, 322–5 (*March–April*, 1946) *In Italian.*—The period of seismic waves is in general observed to increase with distance from the epicentre, but there are exceptions. Since the coefficient of absorption increases with frequency, the wavelength of the impulse might be expected to increase progressively with the distance from the epicentre, owing to the greater absorption of short period components. It is shown, however, by considering the Fourier spectral density of the frequencies, that this may not always be the case. This may provide an explanation of the exceptions. V. C. A. F.

550.36 : 551.311.121 *see Abstr.* 480

550.38 : 551.510.535 *see Abstr.* 483

550.42 : 539.154.2 *see Abstr.* 414

551.16 479

On the internal constitution of the earth. KRONIG, R., DE BOER, J., AND KORRINGA, J. *Physica, 's Grav.*, **12**, 245–56 (*Aug.*, 1946).

551.311.121 : 550.36 480

Thermodynamics of an Ice Age: the cause and sequence of glaciation. LEWIS, G. N. *Science*, **104**, 43–7 (*July* 19, 1946).—Two self-accelerating meteorological processes are invoked: (*a*) the high albedo of an ice surface, by reflecting much solar radiation, cools the neighbourhood and extends the ice; (*b*) the cold, dry air mass over an ice field interacting with warm, moist air at lower latitudes, causes precipitation, which falling at the periphery also extends the ice

field. The humidity of the whole atmosphere is lowered and evaporation increased. Process (*b*) starts when conditions favour a period of maximum evaporation, and mountain building may be a factor. It may cease when process (*a*) has lowered the temperature of tropical waters sufficiently to check evaporation. W. A. R.

551.465 : 532.593 *see Abstr.* 231

METEOROLOGY 551.5

551.508.99 : 621.396.11 : 534.87 *see Abstr.* 271

551.510.41/.42 : 551.594.14 481

The removal of radon from atmospheric air by filtering. NOLAN, P. J., AND FAHY, E. F. *Proc. R. Irish Acad. A*, **50**, 257–60 (*Nov.*, 1945).—The aim of the experiments described was to measure the radon content of Dublin air. The rate of production in a large ionization vessel was measured, and it was found that the radon is removed when the atmospheric air is introduced into the vessel through a cotton-wool filter. The observations of Hess in New York [Abstr. 980 (1944)] disagree with the present results. A possible explanation is given. L. S. G.

551.510.535 482

Geomagnetic control of region F_2 of the ionosphere. MITRA, S. K. *Nature, Lond.*, **158**, 668–9 (*Nov.* 9, 1946).—The geomagnetic control of the ionosphere reported by Appleton [Abstr. 1989 (1946)] suggests a terrestrial origin for the ionosphere, at least in part, owing to the difficulty of external charged particles reaching low latitudes. Attention is directed to the hypothesis that charged particles, originating through t.v. ionization very high in the atmosphere, are directed by the lines of the earth's magnetic field. For example, particles originating at heights of 600–1 200 km over the magnetic equator and following the earth's field, would reach a height of 400 km (where collisional frequency would begin to prevent further progress) at regions of magnetic dip value about 28°, where Appleton's two peaks lie. That ionized particles exist at heights of 600–1 200 km is shown by the sunlit auroras [Störmer, *Nature, Lond.*, **123**, 868 (1929)].

551.510.535 : 537.122 : 537.563 *see Abstr.* 365

551.510.535 : 537.564 *see Abstr.* 366

551.510.535 : 550.38 483

Geomagnetic time variations and their relations to ionospheric conditions. CHAKRABARTY, S. K. *Curr. Sci.*, **15**, 246–7 (*Sept.*, 1946).—Comparison of magnetic records at different observatories (San Juan, Alibag, Huancayo) show that the quiet day solar diurnal variations S_q at low but equal geographical latitudes differ widely in intensity and in type. They indicate a geomagnetic control rather than a dependence on geographical latitude. The possible connection of this fact with the dependence of maximum noon ionization of the F_2 layer on the geomagnetic latitude is noted. It is suggested that this layer may be the seat of the S_q current system. V. C. A. F.

551.524.3 : 697 484

Meteorological history and the space heating machine. GRIERSON, R. *Proc. Instn Mech. Engrs, Lond.*, **153** (*War Emerg. Issue No.* 11) 381–408 (1945).—[Abstr. 580 B (1947)].

551.593.5 485

Distribution of brightness and colour over the sky. REESINCK, J. J. M. *Physica, 's Grav.*, **12**, 296–300 (*Aug.*, 1946).

551.594.12 : 537.56 *see Abstr.* 364

551.594.14 : 551.510.41/.42 *see Abstr.* 481

551.594.221 : 537.533.72 *see Abstr.* 355

551.594.221 : 621.316.933(489) = 398 486

Lightning accidents in Denmark 1945. ERNST, L. *Elektroteknikeren*, **42**, 557–67 (*Sept.* 22, 1946) *In Danish.*—[Abstr. 353 B (1947)].

551.594.221 487

Lightning recorded by aeroplane propeller. BRYANT, J. M., AND NEWMAN, M. *J. Appl. Phys.*, **17**, 555–7 (*July*, 1946).—A lightning stroke to the propeller blades of an aeroplane in flight left a remarkably complete record of its own characteristics. Sputtering of the discharge on the rotating blades left a clear time scale of the stroke which lasted at least 0·15 sec. The lightning current direction was also recorded by magnetization of steel rings located in the propeller mechanism. A.

552.513 488

Experimental production of red and yellow sandstones from chalybeate water. RAYLEIGH. *Proc. Roy. Soc. A*, **186** (*No.* 1007) 411–22 (*Sept.* 24, 1946).

BIOLOGY 57/59

578.087.87 : 621.317.33 489

A method for the determination of the components of a complex conductor separated from the surface by semi-conductors. TRIER, M., AND WARBURG, E. *K. Danske Vidensk. Selsk.*, **18** (*No.* 10) 64 *pp.* (1941).—[Abstr. 359 B (1947)].

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612 : 621.396.615.17 490

An improved stimulator for use in elementary physiology classes. WHITFIELD, I. C. *J. Sci. Instrum.*, **23**, 232–3 (*Oct.*, 1946).

612.843.3 491

Color vision and color blindness: a mechanism in terms of modern evidence. JAHN, T. L. *J. Opt. Soc. Amer.*, **36**, 595–7 (*Oct.*, 1946).

612.843.31 : 535.642 492

Colour vision. SHAXBY, J. H. *Phil. Mag.*, **37**, 33–40 (*Jan.*, 1946).—An earlier theory [Abstr. 1949 (1943)] is further developed, and it connects well with the trichromatic theory of the retinal processes concerned

in such matters as colour discrimination and the necessity of desaturating a spectral colour in order to obtain a match with a mixture of the 3 primaries. A new colour equation is given which fits the facts of colour matching for normal observers slightly better than the previous equation. It is also satisfied for the matches made in cases of Trichromatic Anomaly. L. S. G.

612.845.5 493

A screening test for defective red-green vision. HARDY, L. H., RAND, G., AND RITTLER, M. C. *J. Opt. Soc. Amer.*, **36**, 610–14 (*Oct.*, 1946).

612.85 : 534.77 *see Abstr.* 265

615.849.5 : 621.386.1 = 4 494

Spatial distribution of radiation from X-ray tube targets. MALLET, L., AND MAURIN, R. *J. Radiol. Électrol.*, **27** (*Nos.* 7–8) 355–9 (1946) *In French.*—[Abstr. 477 B (1947)].

615.849 : 621.386.1 = 5 495

A therapeutic X-ray tube with circular anode. BOSSI, R. *Ric. Sci. Ricostruz.*, **16**, 622–4 (*May–June*, 1946) *In Italian.*—[Abstr. 476 B (1947)].

615.849.5 = 4 496

Filtration in radiotherapy. MAURICE, L. *J. Radiol. Électrol.*, **26** (*Nos.* 7–8) 235–7 (1944–45) *In French.*—The absorption coefficient of X-rays in water, or, in practice, the transmission through 1 cm of water, is suggested as a criterion of the penetration of the radiation for therapeutic purposes. Using this method, the effect on the penetration of increasing tube voltage only is small, but increasing filtration at a fixed voltage is much more significant. It is pointed out that the practice of stating the inherent filtration of an X-ray therapy tube (oil filling, case, etc.) in terms of equivalent copper filter is misleading. The light elements concerned absorb the radiation without appreciable change in quality. An investigation of the effect of varying filtration on the transmission in water indicates that at 200 kV the optimum economic filter is between 1·0 and 1·5 mm Cu. J. E. R.

666.112.4 : 535.661.3 *see Abstr.* 315

666.113.27 : 539.264 *see Abstr.* 425

669 : 539.377 *see Abstr.* 429

677.1 : 539.412 = 4 *see Abstr.* 430

PHOTOGRAPHY 77

771.534.5 = 82 497

Sensitivity of photographic negative materials. GILEV, S. S. *J. Tech. Phys., USSR*, **16** (*No.* 2) 159–70 (1946) *In Russian.*—The methods of quantitative assessment of the light sensitivity of photographic negative materials are discussed. Present methods are criticized as being more applicable to amateur than to technical photography. D. S.

771.534.553 498

The effect of the angle of incidence of the exposing light rays upon the resolving powers of photographic materials. GREGORY, J. M. *Proc. Phys. Soc., Lond.*, **58**, 769–75 (*Nov.*, 1946).—Experiments have been carried out with a resolving power test object in contact with the photographic material, using illumination at different angles of incidence. The effect is almost undiscernible until angles of 40° are reached, at which it is of the order of 5 to 10% reduction in resolving power with a medium-speed film. With fast film for aerial photography, the effect is barely observable. It is concluded that the drop in resolving power, observed in air camera negatives at points off axis, is not to any appreciable extent due to the above effect. A.

771.534.554 = 5 499

Methods and results of a study of photographic grain. FRACASTORO, M. G. *Ric. Sci. Ricostruz.*, **16**, 75–7 (*Jan.–Feb.*, 1946) *In Italian.*—A study of the characteristics of photographic emulsions has led to a method of expressing graininess in terms of the variation of density measured by a microphotometer. J. W. T. W.

778.33 = 4 500

Radiographic control by means of echelon filters. SERVAIS, M. *J. Radiol. Électrol.*, **26** (*Nos.* 9–10) 298–306 (1944–45) *In French.*—A common difficulty in radiography arises in the comparison of results from different X-ray generators. It is suggested that such comparisons may be simplified if the radiations used are specified in terms of the transmission through an echelon or step wedge of copper. A number of such filters with 0·1 mm Cu steps are described. A specification of the radiation used in taking a radiograph can then be made in terms of the step number producing minimum visible photographic impression, and the range of steps over which useful blackening is obtained. Examples of the use of the filters are given. J. E. R.

778.37 501

Multiple photos with the Microflash. *Gen. Radio Exp.*, **20**, 5 (*April*, 1946).—An electronic sequence timer permits multiple exposures on a single film from 6 Microflash lamps adjustable to operate at intervals between 0·6 and 0·0003 sec. The apparatus has been used for bullet photography, studying rupturing propeller blades, etc. P. O.